

| | | | | | |
|--|--|---|---|--|--------------------|
| AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT | | | 1. CONTRACT ID CODE N/A | | PAGE 1 OF 54 PAGES |
| 2. AMENDMENT/MODIFICATION NO. 0001 | | 3. EFFECTIVE DATE AUG 01, 2003 | | 4. REQUISITION/PURCHASE REQ. NO. N/A | |
| | | | | 5. PROJECT NO. (If applicable) SPEC. NO. 1312 | |
| 6. ISSUED BY CODE | | 7. ADMINISTERED BY (If other than Item 6) CODE | | | |
| DEPARTMENT OF THE ARMY U.S. ARMY ENGINEER DISTRICT, SACRAMENTO SACRAMENTO, CALIFORNIA 95814-2922 | | | DEPARTMENT OF THE ARMY US ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT P.O. BOX 532711 LOS ANGELES, CALIFORNIA 90053-2325 | | |

| | | | | |
|---|--|---------------|---|--|
| 8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code) | | (✓) | 9A. AMENDMENT OF SOLICITATION NO. | |
| | | X | DACA09-03-B-0009 | |
| | | | 9B. DATED (SEE ITEM 11) N/A | |
| | | | 10A. MODIFICATION OF CONTRACTS/ORDER NO. N/A | |
| | | | 10B. DATED (SEE ITEM 13) N/A | |
| CODE | | FACILITY CODE | | |

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☒ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods:

(a) By completing Items 8 and 15, and returning 1 copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

| | |
|--|-----------------------------|
| 12. ACCOUNTING AND APPROPRIATION DATA (If required) N/A | NOTE: ITEM 13 BELOW IS N/A. |
|--|-----------------------------|

13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS, IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

| | |
|-----|---|
| (✓) | A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A. N/A |
| | B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b). |
| | C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF: |
| | D. OTHER (Specify type of modification and authority) N/A |

E. IMPORTANT: Contractor ☐ is not, ☐ is required to sign this document and return _____ copies to the issuing office.

| |
|--|
| 14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.) UAV Training Facility Ft. Huachuca, AZ |
|--|

- 2 Encl
- Revised Pages: Table of Contents (Page 4), Attachment No 5 - Drawing List, Section 16264(New), Section 16410(New)
 - Revised Drawings: See Attachment No. 5 Drawing List (41 Drawings Revised)

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

| | | | |
|---|--|--|--|
| 15A. NAME AND TITLE OF SIGNER (Type or print) | | 16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print) | |
| 15B. CONTRACTOR/OFFEROR | | 16B. UNITED STATES OF AMERICA | |
| (Signature of person authorized to sign) | | BY (Signature of Contracting Officer) | |
| 15C. DATE SIGNED | | 16C. DATE SIGNED | |

DIVISION 14 - CONVEYING SYSTEMS

14630A OVERHEAD ELECTRIC CRANES

DIVISION 15 - MECHANICAL


15070 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT
15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS
15190 GAS PIPING SYSTEMS
15400 PLUMBING, GENERAL PURPOSE
15566 WARM AIR HEATING SYSTEMS
15620 LIQUID CHILLERS
15690 EVAPORATIVE COOLING/NATURAL GAS FIRED UNIT SYSTEMS
15700 UNITARY HEATING AND COOLING EQUIPMENT
15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM
15951 DIRECT DIGITAL CONTROL FOR HVAC
15990 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS
15995 COMMISSIONING OF HVAC SYSTEMS

DIVISION 16 - ELECTRICAL

16070 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT
16264 DIESEL GENERATOR SET, STATIONARY 15-300 Kw, STANDBY APPLICATION
16265 UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEM ABOVE 15KVA CAPACITY
16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND
16410 AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH
16415 ELECTRICAL WORK, INTERIOR
16528 EXTERIOR LIGHTING
16665 STATIC ELECTRICITY PROTECTION SYSTEM
16710 PREMISES DISTRIBUTION SYSTEM
16711 TELEPHONE SYSTEM, OUTSIDE PLANT
16721 INTERCOMMUNICATION SYSTEM
16770 RADIO AND PUBLIC ADDRESS SYSTEMS

SCHEDULE OF DRAWINGS

| SEQ. NO. | SHT. NO. | DRAWING TITLE | SEQ. NO. | DRAWING TITLE | SEQ. NO. | SHT. NO. | DRAWING TITLE |
|----------|----------|---|----------|---------------|--|----------|--|
| 153 | FP1.03 | FIRE PROTECTION (CONTINUED) | 181 | E1.23 | AIB ANNEX FIRE ALARM, IDS, AND PA FLOOR PLAN | E5.08 | AIB ANNEX CABLE AND TRANSFORMER SCHEDULES AND DETAILS |
| | | FIRE PROTECTION PLAN, PRE-ENGINEERED | 182 | E1.24 | AIB ANNEX LIGHTNING PROTECTION & GROUNDING PLAN | | |
| | | MAINTENANCE OPERATIONS BUILDING | 183 | E5.01 | RUGGE-HAMILTON ELECTRICAL/COMMUNICATIONS | 216 | AIB ANNEX PANEL SCHEDULES |
| 154 | FP1.04 | MAINTENANCE FACILITY #2 | | | SITE DETAILS I | 217 | AIB ANNEX FIRE ALARM RISER DIAGRAM |
| 155 | FP5.00 | FIRE PROTECTION DETAILS | 184 | E5.02 | RUGGE-HAMILTON ELECTRICAL/COMMUNICATIONS | 218 | AIB ANNEX CARD ACCESS CONTROL, IDS AND PA RISER DIAGRAMS |
| | | ELECTRICAL | 185 | E5.03 | RUGGE-HAMILTON GROUNDING DETAILS | 219 | AIB ANNEX TELECOMMUNICATIONS RISER DIAGRAM |
| 156 | E0.01 | RUGGE-HAMILTON ELECTRICAL LEGEND | 186 | E5.04 | RUGGE-HAMILTON LIGHTNING PROTECTION DETAILS | | |
| 157 | E0.02 | RUGGE-HAMILTON ELECTRICAL LEGEND & ABBREVIATIONS | 187 | E5.05 | RUGGE-HAMILTON COMMUNICATIONS DETAILS I | | |
| 158 | E0.03 | AIB ANNEX ELECTRICAL LEGEND AND ABBREVIATIONS | 188 | E5.06 | RUGGE-HAMILTON COMMUNICATIONS DETAILS II | | |
| 159 | E1.01 | ELECTRICAL SITE KEY PLAN | 189 | E5.07 | RUGGE-HAMILTON LIGHTING FIXTURE SCHEDULE AND DETAILS | | |
| 160 | E1.02 | RUGGE-HAMILTON ELECTRICAL SITE PLAN | 190 | E5.08 | RUGGE-HAMILTON LIGHTING FIXTURE DETAILS I | | |
| 161 | E1.03 | RUGGE-HAMILTON FLIGHT OPERATIONS ELECTRICAL SITE PLAN | 191 | E5.09 | RUGGE-HAMILTON LIGHTING FIXTURE DETAILS II | | |
| 162 | E1.04 | RUGGE-HAMILTON MAINTENANCE OPERATIONS ELECTRICAL | 192 | E5.10 | AIB ANNEX ELECTRICAL AND COMMUNICATIONS SITE DETAILS | | |
| 163 | E1.05 | RUGGE-HAMILTON MAINTENANCE FACILITY #2 | 193 | E5.11 | AIB ANNEX COMMUNICATIONS MANHOLE DETAILS | | |
| 164 | E1.06 | RUGGE-HAMILTON MAINTENANCE FACILITY #2 | 194 | E5.12 | AIB ANNEX PADMOUNTED AIR SWITCH AND ELECTRICAL MANHOLE DETAILS | | |
| 165 | E1.07 | AIB ANNEX ELECTRICAL AND COMMUNICATIONS SITE PLAN | 195 | E5.13 | AIB ANNEX POWER DETAILS | | |
| 166 | E1.08 | AIB ANNEX COMMUNICATIONS UPGRADE | 196 | E5.14 | AIB ANNEX INSTRUCTOR'S CONTROL CONSOLE POWER CONTROL DETAILS | | |
| 167 | E1.09 | BLACK TOWER ROAD SITE PLAN II | 197 | E5.15 | AIB ANNEX POWER AND COMMUNICATIONS SIMULATOR MULTI-OUTLET FLOOR BOX DETAILS | | |
| 168 | E1.10 | BLACK TOWER ROAD SITE PLAN I | 198 | E5.16 | AIB ANNEX POWER AND COMMUNICATIONS CLASSROOM MULTI-OUTLET WALL/FLOOR BOX DETAILS | | |
| 169 | E1.11 | PIONEER ROAD SITE PLAN | 199 | E5.17 | AIB ANNEX FIRE ALARM AIR SAMPLING PIPING DETAILS | | |
| 170 | E1.12 | RUGGE-HAMILTON MAINTENANCE OPERATIONS POWER & SIGNAL FLOOR PLAN | 200 | E5.18 | AIB ANNEX LIGHTNING PROTECTION AND GROUNDING DETAILS | | |
| 171 | E1.13 | RUGGE-HAMILTON FLIGHT OPERATIONS POWER & SIGNAL FLOOR PLAN | 201 | E5.19 | AIB ANNEX SIMULATOR ROOM FLOUORESCENT LIGHTING CONTROL DETAILS | | |
| 172 | E1.14 | RUGGE-HAMILTON MAINTENANCE FACILITY #2 | 202 | E5.20 | AIB ANNEX SIMULATOR ROOM INCANDESCENT SPOT LIGHTING CONTROL DETAILS | | |
| 173 | E1.15 | RUGGE-HAMILTON MAINTENANCE OPERATIONS | 203 | E5.21 | AIB ANNEX LIGHTING FIXTURE SCHEDULE AND DETAILS | | |
| 174 | E1.16 | RUGGE-HAMILTON FLIGHT OPERATIONS | 204 | E5.22 | AIB ANNEX LIGHTING FIXTURE DETAILS I | | |
| 175 | E1.17 | RUGGE-HAMILTON MAINTENANCE FACILITY #2 | 205 | E5.23 | AIB ANNEX LIGHTING FIXTURE DETAILS II | | |
| 176 | E1.18 | RUGGE-HAMILTON MAINTENANCE OPERATIONS | 206 | E5.24 | RUGGE-HAMILTON LIGHTING FIXTURE DETAILS III | | |
| 177 | E1.19 | RUGGE-HAMILTON FLIGHT OPERATIONS | 207 | E6.00 | RUGGE-HAMILTON ELECTRICAL ONE-LINE DIAGRAM | | |
| 178 | E1.20 | AIB ANNEX POWER FLOOR PLAN | 208 | E6.01 | RUGGE-HAMILTON PANEL-BOARD SCHEDULES | | |
| 179 | E1.21 | AIB ANNEX COMMUNICATIONS FLOOR PLAN | 209 | E6.02 | RUGGE-HAMILTON LIFT STATION ELECTRICAL ONE-LINE DIAGRAM | | |
| 180 | E1.22 | AIB ANNEX LIGHTING FLOOR PLAN | 210 | E6.03 | RUGGE-HAMILTON LIFT STATION CONTROL DIAGRAM | | |
| | | | 211 | E6.04 | RUGGE-HAMILTON FIRE ALARM RISER DIAGRAM | | |
| | | | 212 | E6.05 | RUGGE-HAMILTON IDS, PA AND IC RISER DIAGRAMS | | |
| | | | 213 | E6.06 | RUGGE-HAMILTON TELECOMMUNICATIONS RISER DIAGRAM | | |
| | | | 214 | E6.07 | AIB ANNEX POWER ONE-LINE DIAGRAM | | |



US Army Corps of Engineers
Sacramento District

| Rev. | Date | By | Description |
|------|----------|------------|-------------|
| 1 | 07/02/03 | J. LEWIS | DESIGN |
| 2 | 07/02/03 | J. LEWIS | DESIGN |
| 3 | 07/02/03 | J. LEWIS | DESIGN |
| 4 | 07/02/03 | J. LEWIS | DESIGN |
| 5 | 07/02/03 | J. LEWIS | DESIGN |
| 6 | 07/02/03 | J. LEWIS | DESIGN |
| 7 | 07/02/03 | J. LEWIS | DESIGN |
| 8 | 07/02/03 | J. LEWIS | DESIGN |
| 9 | 07/02/03 | J. LEWIS | DESIGN |
| 10 | 07/02/03 | J. LEWIS | DESIGN |
| 11 | 07/02/03 | J. LEWIS | DESIGN |
| 12 | 07/02/03 | J. LEWIS | DESIGN |
| 13 | 07/02/03 | J. LEWIS | DESIGN |
| 14 | 07/02/03 | J. LEWIS | DESIGN |
| 15 | 07/02/03 | J. LEWIS | DESIGN |
| 16 | 07/02/03 | J. LEWIS | DESIGN |
| 17 | 07/02/03 | J. LEWIS | DESIGN |
| 18 | 07/02/03 | J. LEWIS | DESIGN |
| 19 | 07/02/03 | J. LEWIS | DESIGN |
| 20 | 07/02/03 | J. LEWIS | DESIGN |
| 21 | 07/02/03 | J. LEWIS | DESIGN |
| 22 | 07/02/03 | J. LEWIS | DESIGN |
| 23 | 07/02/03 | J. LEWIS | DESIGN |
| 24 | 07/02/03 | J. LEWIS | DESIGN |
| 25 | 07/02/03 | J. LEWIS | DESIGN |
| 26 | 07/02/03 | J. LEWIS | DESIGN |
| 27 | 07/02/03 | J. LEWIS | DESIGN |
| 28 | 07/02/03 | J. LEWIS | DESIGN |
| 29 | 07/02/03 | J. LEWIS | DESIGN |
| 30 | 07/02/03 | J. LEWIS | DESIGN |
| 31 | 07/02/03 | J. LEWIS | DESIGN |
| 32 | 07/02/03 | J. LEWIS | DESIGN |
| 33 | 07/02/03 | J. LEWIS | DESIGN |
| 34 | 07/02/03 | J. LEWIS | DESIGN |
| 35 | 07/02/03 | J. LEWIS | DESIGN |
| 36 | 07/02/03 | J. LEWIS | DESIGN |
| 37 | 07/02/03 | J. LEWIS | DESIGN |
| 38 | 07/02/03 | J. LEWIS | DESIGN |
| 39 | 07/02/03 | J. LEWIS | DESIGN |
| 40 | 07/02/03 | J. LEWIS | DESIGN |
| 41 | 07/02/03 | J. LEWIS | DESIGN |
| 42 | 07/02/03 | J. LEWIS | DESIGN |
| 43 | 07/02/03 | J. LEWIS | DESIGN |
| 44 | 07/02/03 | J. LEWIS | DESIGN |
| 45 | 07/02/03 | J. LEWIS | DESIGN |
| 46 | 07/02/03 | J. LEWIS | DESIGN |
| 47 | 07/02/03 | J. LEWIS | DESIGN |
| 48 | 07/02/03 | J. LEWIS | DESIGN |
| 49 | 07/02/03 | J. LEWIS | DESIGN |
| 50 | 07/02/03 | J. LEWIS | DESIGN |
| 51 | 07/02/03 | J. LEWIS | DESIGN |
| 52 | 07/02/03 | J. LEWIS | DESIGN |
| 53 | 07/02/03 | J. LEWIS | DESIGN |
| 54 | 07/02/03 | J. LEWIS | DESIGN |
| 55 | 07/02/03 | J. LEWIS | DESIGN |
| 56 | 07/02/03 | J. LEWIS | DESIGN |
| 57 | 07/02/03 | J. LEWIS | DESIGN |
| 58 | 07/02/03 | J. LEWIS | DESIGN |
| 59 | 07/02/03 | J. LEWIS | DESIGN |
| 60 | 07/02/03 | J. LEWIS | DESIGN |
| 61 | 07/02/03 | J. LEWIS | DESIGN |
| 62 | 07/02/03 | J. LEWIS | DESIGN |
| 63 | 07/02/03 | J. LEWIS | DESIGN |
| 64 | 07/02/03 | J. LEWIS | DESIGN |
| 65 | 07/02/03 | J. LEWIS | DESIGN |
| 66 | 07/02/03 | J. LEWIS | DESIGN |
| 67 | 07/02/03 | J. LEWIS | DESIGN |
| 68 | 07/02/03 | J. LEWIS | DESIGN |
| 69 | 07/02/03 | J. LEWIS | DESIGN |
| 70 | 07/02/03 | J. LEWIS | DESIGN |
| 71 | 07/02/03 | J. LEWIS | DESIGN |
| 72 | 07/02/03 | J. LEWIS | DESIGN |
| 73 | 07/02/03 | J. LEWIS | DESIGN |
| 74 | 07/02/03 | J. LEWIS | DESIGN |
| 75 | 07/02/03 | J. LEWIS | DESIGN |
| 76 | 07/02/03 | J. LEWIS | DESIGN |
| 77 | 07/02/03 | J. LEWIS | DESIGN |
| 78 | 07/02/03 | J. LEWIS | DESIGN |
| 79 | 07/02/03 | J. LEWIS | DESIGN |
| 80 | 07/02/03 | J. LEWIS | DESIGN |
| 81 | 07/02/03 | J. LEWIS | DESIGN |
| 82 | 07/02/03 | J. LEWIS | DESIGN |
| 83 | 07/02/03 | J. LEWIS | DESIGN |
| 84 | 07/02/03 | J. LEWIS | DESIGN |
| 85 | 07/02/03 | J. LEWIS | DESIGN |
| 86 | 07/02/03 | J. LEWIS | DESIGN |
| 87 | 07/02/03 | J. LEWIS | DESIGN |
| 88 | 07/02/03 | J. LEWIS | DESIGN |
| 89 | 07/02/03 | J. LEWIS | DESIGN |
| 90 | 07/02/03 | J. LEWIS | DESIGN |
| 91 | 07/02/03 | J. LEWIS | DESIGN |
| 92 | 07/02/03 | J. LEWIS | DESIGN |
| 93 | 07/02/03 | J. LEWIS | DESIGN |
| 94 | 07/02/03 | J. LEWIS | DESIGN |
| 95 | 07/02/03 | J. LEWIS | DESIGN |
| 96 | 07/02/03 | J. LEWIS | DESIGN |
| 97 | 07/02/03 | J. LEWIS | DESIGN |
| 98 | 07/02/03 | J. LEWIS | DESIGN |
| 99 | 07/02/03 | J. LEWIS | DESIGN |
| 100 | 07/02/03 | J. LEWIS | DESIGN |
| 101 | 07/02/03 | J. LEWIS | DESIGN |
| 102 | 07/02/03 | J. LEWIS | DESIGN |
| 103 | 07/02/03 | J. LEWIS | DESIGN |
| 104 | 07/02/03 | J. LEWIS | DESIGN |
| 105 | 07/02/03 | J. LEWIS | DESIGN |
| 106 | 07/02/03 | J. LEWIS | DESIGN |
| 107 | 07/02/03 | J. LEWIS | DESIGN |
| 108 | 07/02/03 | J. LEWIS | DESIGN |
| 109 | 07/02/03 | J. LEWIS | DESIGN |
| 110 | 07/02/03 | J. LEWIS | DESIGN |
| 111 | 07/02/03 | J. LEWIS | DESIGN |
| 112 | 07/02/03 | J. LEWIS | DESIGN |
| 113 | 07/02/03 | J. LEWIS | DESIGN |
| 114 | 07/02/03 | J. LEWIS | DESIGN |
| 115 | 07/02/03 | J. LEWIS | DESIGN |
| 116 | 07/02/03 | J. LEWIS | DESIGN |
| 117 | 07/02/03 | J. LEWIS | DESIGN |
| 118 | 07/02/03 | J. LEWIS | DESIGN |
| 119 | 07/02/03 | J. LEWIS | DESIGN |
| 120 | 07/02/03 | J. LEWIS | DESIGN |
| 121 | 07/02/03 | J. LEWIS | DESIGN |
| 122 | 07/02/03 | J. LEWIS | DESIGN |
| 123 | 07/02/03 | J. LEWIS | DESIGN |
| 124 | 07/02/03 | J. LEWIS | DESIGN |
| 125 | 07/02/03 | J. LEWIS | DESIGN |
| 126 | 07/02/03 | J. LEWIS | DESIGN |
| 127 | 07/02/03 | J. LEWIS | DESIGN |
| 128 | 07/02/03 | J. LEWIS | DESIGN |
| 129 | 07/02/03 | J. LEWIS | DESIGN |
| 130 | 07/02/03 | J. LEWIS | DESIGN |
| 131 | 07/02/03 | J. LEWIS | DESIGN |
| 132 | 07/02/03 | J. LEWIS | DESIGN |
| 133 | 07/02/03 | J. LEWIS | DESIGN |
| 134 | 07/02/03 | J. LEWIS | DESIGN |
| 135 | 07/02/03 | J. LEWIS | DESIGN |
| 136 | 07/02/03 | J. LEWIS | DESIGN |
| 137 | 07/02/03 | J. LEWIS | DESIGN |
| 138 | 07/02/03 | J. LEWIS | DESIGN |
| 139 | 07/02/03 | J. LEWIS | DESIGN |
| 140 | 07/02/03 | J. LEWIS | DESIGN |
| 141 | 07/02/03 | J. LEWIS | DESIGN |
| 142 | 07/02/03 | J. LEWIS | DESIGN |
| 143 | 07/02/03 | J. LEWIS | DESIGN |
| 144 | 07/02/03 | J. LEWIS | DESIGN |
| 145 | 07/02/03 | J. LEWIS | DESIGN |
| 146 | 07/02/03 | J. LEWIS | DESIGN |
| 147 | 07/02/03 | J. LEWIS | DESIGN |
| 148 | 07/02/03 | J. LEWIS | DESIGN |
| 149 | 07/02/03 | J. LEWIS | DESIGN |
| 150 | 07/02/03 | J. LEWIS | DESIGN |
| 151 | 07/02/03 | J. LEWIS | DESIGN |
| 152 | 07/02/03 | J. LEWIS | DESIGN |
| 153 | 07/02/03 | J. LEWIS | DESIGN |
| 154 | 07/02/03 | J. LEWIS | DESIGN |
| 155 | 07/02/03 | J. LEWIS | DESIGN |
| 156 | 07/02/03 | J. LEWIS | DESIGN |
| 157 | 07/02/03 | J. LEWIS | DESIGN |
| 158 | 07/02/03 | J. LEWIS | DESIGN |
| 159 | 07/02/03 | J. LEWIS | DESIGN |
| 160 | 07/02/03 | J. LEWIS | DESIGN |
| 161 | 07/02/03 | J. LEWIS | DESIGN |
| 162 | 07/02/03 | J. LEWIS | DESIGN |
| 163 | 07/02/03 | J. LEWIS | DESIGN |
| 164 | 07/02/03 | J. LEWIS | DESIGN |
| 165 | 07/02/03 | J. LEWIS | DESIGN |
| 166 | 07/02/03 | J. LEWIS | DESIGN |
| 167 | 07/02/03 | J. LEWIS | DESIGN |
| 168 | 07/02/03 | J. LEWIS | DESIGN |
| 169 | 07/02/03 | J. LEWIS | DESIGN |
| 170 | 07/02/03 | J. LEWIS | DESIGN |
| 171 | 07/02/03 | J. LEWIS | DESIGN |
| 172 | 07/02/03 | J. LEWIS | DESIGN |
| 173 | 07/02/03 | J. LEWIS | DESIGN |
| 174 | 07/02/03 | J. LEWIS | DESIGN |
| 175 | 07/02/03 | J. LEWIS | DESIGN |
| 176 | 07/02/03 | J. LEWIS | DESIGN |
| 177 | 07/02/03 | J. LEWIS | DESIGN |
| 178 | 07/02/03 | J. LEWIS | DESIGN |
| 179 | 07/02/03 | J. LEWIS | DESIGN |
| 180 | 07/02/03 | J. LEWIS | DESIGN |
| 181 | 07/02/03 | J. LEWIS | DESIGN |
| 182 | 07/02/03 | J. LEWIS | DESIGN |
| 183 | 07/02/03 | J. LEWIS | DESIGN |
| 184 | 07/02/03 | J. LEWIS | DESIGN |
| 185 | 07/02/03 | J. LEWIS | DESIGN |
| 186 | 07/02/03 | J. LEWIS | DESIGN |
| 187 | 07/02/03 | J. LEWIS | DESIGN |
| 188 | 07/02/03 | J. LEWIS | DESIGN |
| 189 | 07/02/03 | J. LEWIS | DESIGN |
| 190 | 07/02/03 | J. LEWIS | DESIGN |
| 191 | 07/02/03 | J. LEWIS | DESIGN |
| 192 | 07/02/03 | J. LEWIS | DESIGN |
| 193 | 07/02/03 | J. LEWIS | DESIGN |
| 194 | 07/02/03 | J. LEWIS | DESIGN |
| 195 | 07/02/03 | J. LEWIS | DESIGN |
| 196 | 07/02/03 | J. LEWIS | DESIGN |
| 197 | 07/02/03 | J. LEWIS | DESIGN |
| 198 | 07/02/03 | J. LEWIS | DESIGN |
| 199 | 07/02/03 | J. LEWIS | DESIGN |
| 200 | 07/02/03 | J. LEWIS | DESIGN |
| 201 | 07/02/03 | J. LEWIS | DESIGN |
| 202 | 07/02/03 | J. LEWIS | DESIGN |
| 203 | 07/02/03 | J. LEWIS | DESIGN |
| 204 | 07/02/03 | J. LEWIS | DESIGN |
| 205 | 07/02/03 | J. LEWIS | DESIGN |
| 206 | 07/02/03 | J. LEWIS | DESIGN |
| 207 | 07/02/03 | J. LEWIS | DESIGN |
| 208 | 07/02/03 | J. LEWIS | DESIGN |
| 209 | 07/02/03 | J. LEWIS | DESIGN |
| 210 | 07/02/03 | J. LEWIS | DESIGN |
| 211 | 07/02/03 | J. LEWIS | DESIGN |
| 212 | 07/02/03 | J. LEWIS | DESIGN |
| 213 | 07/02/03 | J. LEWIS | DESIGN |
| 214 | 07/02/03 | J. LEWIS | DESIGN |
| 215 | 07/02/03 | J. LEWIS | DESIGN |
| 216 | 07/02/03 | J. LEWIS | DESIGN |
| 217 | 07/02/03 | J. LEWIS | DESIGN |
| 218 | 07/02/03 | J. LEWIS | DESIGN |
| 219 | 07/02/03 | J. LEWIS | DESIGN |
| 220 | 07/02/03 | J. LEWIS | DESIGN |
| 221 | 07/02/03 | J. LEWIS | DESIGN |
| 222 | 07/02/03 | J. LEWIS | DESIGN |
| 223 | 07/02/03 | J. LEWIS | DESIGN |
| 224 | 07/02/03 | J. LEWIS | DESIGN |
| 225 | 07/02/03 | J. LEWIS | DESIGN |
| 226 | 07/02/03 | J. LEWIS | DESIGN |
| 227 | 07/02/03 | J. LEWIS | DESIGN |
| 228 | 07/02/03 | J. LEWIS | DESIGN |
| 229 | 07/02/03 | J. LEWIS | DESIGN |
| 230 | 07/02/03 | J. LEWIS</ | |

SECTION TABLE OF CONTENTS

DIVISION 16 - ELECTRICAL

SECTION 16264A

DIESEL-GENERATOR SET, STATIONARY 15-300 KW, STANDBY APPLICATIONS

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 SYSTEM DESCRIPTION
 - 1.3.1 Engine-Generator Parameter Schedule
 - 1.3.2 Output Capacity
 - 1.3.3 Power Rating
- 1.4 GENERAL REQUIREMENTS
 - 1.4.1 Engine-Generator Set
 - 1.4.2 Nameplates
 - 1.4.3 Personnel Safety Device
 - 1.4.4 Verification of Dimensions
 - 1.4.5 Conformance to Codes and Standards
 - 1.4.6 Site Welding
 - 1.4.7 Engine Generator Set Enclosure
 - 1.4.8 Vibration Isolation
 - 1.4.9 Experience
 - 1.4.10 Field Engineer
 - 1.4.11 Seismic Requirements
- 1.5 STORAGE AND INSTALLATION
- 1.6 OPERATION AND MAINTENANCE MANUALS
 - 1.6.1 Operation Manual
 - 1.6.2 Maintenance Manual
- 1.7 SPECIAL TOOLS AND FILTERS

PART 2 PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT
 - 2.1.1 Circuit Breakers, Low Voltage
 - 2.1.2 Filter Elements (Fuel-oil, Lubricating-oil, and Combustion-air)
 - 2.1.3 Instrument Transformers
 - 2.1.4 Pipe (Sleeves, Fuel/Lube-oil, Compressed-Air, Coolant and Exhaust)
 - 2.1.5 Pipe Flanges and Fittings
 - 2.1.6 Pipe Hangers
 - 2.1.7 Electrical Enclosures
 - 2.1.7.1 General
 - 2.1.7.2 Panelboards
 - 2.1.8 Electric Motors
 - 2.1.9 Motor Controllers
- 2.2 ENGINE
- 2.3 FUEL SYSTEM
 - 2.3.1 Pumps
 - 2.3.1.1 Main Pump
 - 2.3.1.2 Auxiliary Fuel Pump

- 2.3.2 Filter
- 2.3.3 Relief/Bypass Valve
- 2.3.4 Day Tank
 - 2.3.4.1 Capacity, Standby
 - 2.3.4.2 Drain Line
 - 2.3.4.3 Local Fuel Fill
 - 2.3.4.4 Fuel Level Controls
 - 2.3.4.5 Arrangement
- 2.4 LUBRICATION
 - 2.4.1 Filter
 - 2.4.2 Lube-Oil Sensors
- 2.5 COOLING SYSTEM
 - 2.5.1 Coolant Pumps
 - 2.5.2 Heat Exchanger
 - 2.5.2.1 Fin-Tube-Type Heat Exchanger (Radiator)
 - 2.5.3 Ductwork
 - 2.5.4 Temperature Sensors
- 2.6 AIR INTAKE EQUIPMENT
- 2.7 EXHAUST SYSTEM
 - 2.7.1 Flexible Sections and Expansion Joints
 - 2.7.2 Exhaust Muffler
 - 2.7.3 Exhaust Piping
- 2.8 EMISSIONS
- 2.9 STARTING SYSTEM
 - 2.9.1 Controls
 - 2.9.2 Capacity
 - 2.9.3 Functional Requirements
 - 2.9.4 Battery
 - 2.9.5 Battery Charger
 - 2.9.6 Starting Aids
 - 2.9.6.1 Glow Plugs
 - 2.9.6.2 Jacket-Coolant Heaters
- 2.10 GOVERNOR
- 2.11 GENERATOR
 - 2.11.1 Current Balance
 - 2.11.2 Voltage Balance
 - 2.11.3 Waveform
- 2.12 EXCITER
- 2.13 VOLTAGE REGULATOR
 - 2.13.1 Steady State Performance (Regulation or Voltage Droop).
- 2.14 GENERATOR PROTECTION
 - 2.14.1 Panelboards
 - 2.14.2 Devices
- 2.15 SAFETY SYSTEM
 - 2.15.1 Audible Signal
 - 2.15.2 Visual Signal Signal
 - 2.15.3 Alarms and Action Logic
 - 2.15.3.1 Shutdown
 - 2.15.3.2 Problem
 - 2.15.4 Local Alarm Panel
 - 2.15.5 Time-Delay on Alarms
- 2.16 ENGINE GENERATOR SET CONTROLS AND INSTRUMENTATION
 - 2.16.1 Controls
 - 2.16.2 Engine Generator Set Metering and Status Indication
- 2.17 PANELS
 - 2.17.1 Enclosures
 - 2.17.2 Analog
 - 2.17.3 Electronic
 - 2.17.4 Parameter Display

- 2.17.5 Exerciser
- 2.18 SURGE PROTECTION
- 2.19 AUTOMATIC ENGINE-GENERATOR-SET SYSTEM OPERATION
 - 2.19.1 Automatic Transfer Switch
 - 2.19.2 Monitoring and Transfer
- 2.20 MANUAL ENGINE-GENERATOR SET SYSTEM OPERATION
- 2.21 BASE
- 2.22 THERMAL INSULATION
- 2.23 PAINTING AND FINISHING
- 2.24 FACTORY INSPECTION AND TESTS

PART 3 EXECUTION

- 3.1 GENERAL INSTALLATION
- 3.2 PIPING INSTALLATION
 - 3.2.1 General
 - 3.2.2 Supports
 - 3.2.2.1 Ceiling and Roof
 - 3.2.2.2 Wall
 - 3.2.3 Flanged Joints
 - 3.2.4 Cleaning
 - 3.2.5 Pipe Sleeves
- 3.3 ELECTRICAL INSTALLATION
 - 3.3.1 Vibration Isolation
- 3.4 FIELD PAINTING
- 3.5 ONSITE INSPECTION AND TESTS
 - 3.5.1 Test Conditions
 - 3.5.1.1 Data
 - 3.5.1.2 Power Factor
 - 3.5.1.3 Contractor Supplied Items
 - 3.5.1.4 Instruments
 - 3.5.1.5 Sequence
 - 3.5.2 Construction Tests
 - 3.5.2.1 Piping Test
 - 3.5.2.2 Electrical Equipment Tests
 - 3.5.3 Inspections
 - 3.5.4 Safety Run Tests
 - 3.5.5 Performance Tests
 - 3.5.5.1 Continuous Engine Load Run Test
 - 3.5.5.2 Load Acceptance Test
 - 3.5.6 Automatic Operation Tests for Stand-Alone Operation
- 3.6 FINAL INSPECTION AND TESTING
- 3.7 MANUFACTURER'S FIELD SERVICE
 - 3.7.1 Onsite Training
 - 3.7.2 Manufacturer's Representative
- 3.8 INSTRUCTIONS
- 3.9 ACCEPTANCE

-- End of Section Table of Contents --

SECTION 16264A

DIESEL-GENERATOR SET, STATIONARY 15-300 KW, STANDBY APPLICATIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- | | |
|-------------|--|
| ANSI C12.11 | (1987; R 1993) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV) |
| ANSI C39.1 | (1981; R 1992) Requirements for Electrical Analog Indicating Instruments |

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|-------------------|--|
| ASTM A 53/A 53M | (1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A 106 | (1999e1) Seamless Carbon Steel Pipe for High-Temperature Service |
| ASTM A 135 | (1997c) Electric-Resistance-Welded Steel Pipe |
| ASTM A 181/A 181M | (2000) Carbon Steel Forgings for General-Purpose Piping |
| ASTM A 234/A 234M | (2000) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service |
| ASTM B 395 | (1995) U-Bend Seamless Copper and Copper Alloy Heat Exchanger and Condenser Tubes |
| ASTM B 395M | (1995) U-Bend Seamless Copper and Copper Alloy Heat Exchanger and Condenser Tubes (Metric) |
| ASTM D 975 | (1998b) Diesel Fuel Oils |

ASME INTERNATIONAL (ASME)

- | | |
|------------|--|
| ASME B16.3 | (1998) Malleable Iron Threaded Fittings |
| ASME B16.5 | (1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 thru NPS 24 |

| | |
|-----------------------|--|
| ASME B16.11 | (1996) Forged Fittings, Socket-Welding and Threaded |
| ASME B31.1 | (1998) Power Piping |
| ASME BPVC SEC VIII D1 | (1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage |
| ASME BPVC SEC IX | (1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications |

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

| | |
|----------|---|
| AEIC CS5 | (1994; CS5a-1995) Cross-Linked Polyethylene Insulated Shielded Power Cables Rated 5 Through 46 kV |
| AEIC CS6 | (1996) Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 Through 69 kV |

ELECTRICAL GENERATING SYSTEMS ASSOCIATION (EGSA)

| | |
|-----------|--------------------------------------|
| EGSA 101P | (1995a) Engine Driven Generator Sets |
|-----------|--------------------------------------|

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|--------------|---|
| IEEE C2 | (1997) National Electrical Safety Code |
| IEEE Std 1 | (1986; R 1992) General Principles for Temperature Limits in the Rating of Electric Equipment and for the Evaluation of Electrical Insulation |
| IEEE Std 48 | (1998) Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV |
| IEEE Std 81 | (1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1) |
| IEEE Std 100 | (1997) IEEE Standard Dictionary of Electrical and Electronics Terms |
| IEEE Std 120 | (1989) Electrical Measurements in Power Circuits |
| IEEE Std 404 | (1993) Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V Through 138 000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V Through 500 000 V |
| IEEE Std 519 | (1992) Harmonic Control in Electrical Power Systems |

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

| | |
|-----------|---|
| MSS SP-58 | (1993) Pipe Hangers and Supports - Materials, Design and Manufacture |
| MSS SP-69 | (1996) Pipe Hangers and Supports - Selection and Application |
| MSS SP-80 | (1997) Bronze Gate, Globe, Angle and Check Valves |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|------------|---|
| NEMA AB 1 | (1993) Molded Case Circuit Breakers and Molded Case Switches |
| NEMA ICS 2 | (1993) Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC |
| NEMA ICS 6 | (1993) Industrial Control and Systems, Enclosures |
| NEMA WC 74 | (2000) 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy |
| NEMA MG 1 | (1998) Motors and Generators |
| NEMA PB 1 | (1995) Panelboards |
| NEMA SG 3 | (1995) Power Switching Equipment |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|----------|--|
| NFPA 30 | (1996; Errata TIA 96-2) Flammable and Combustible Liquids Code |
| NFPA 37 | (1998) Installation and Use of Stationary Combustion Engines and Gas Turbines |
| NFPA 70 | (1999) National Electrical Code |
| NFPA 99 | (1999) Health Care Facilities |
| NFPA 110 | (1999) Emergency and Standby Power Systems |

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

| | |
|------------|---|
| SAE ARP892 | (1965; R 1994) D-C Starter-Generator, Engine |
| SAE J537 | (1996) Storage Batteries |

UNDERWRITERS LABORATORIES (UL)

| | |
|---------|--|
| UL 489 | (1996; Rev thru Dec 1998) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures |
| UL 891 | (1994; Rev thru Jan 1995) Dead-Front Switchboards |
| UL 1236 | (1994; Rev thru Mar 1999) Battery Chargers for Charging Engine-Starter Batteries |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Layout; G,
Drawings; G,

- a. Base-mounted equipment, complete with base and attachments including anchor bolt template and recommended clearances for maintenance and operation.
- b. Starting system.
- c. Fuel system.
- d. Cooling system.
- e. Exhaust system.
- f. Electric wiring of relays, breakers, programmable controllers, and switches including single line and wiring diagrams.
- g. Lubrication system, including piping, pumps, strainers, filters, heat exchangers for lube oil and turbocharger cooling, controls and wiring.
- h. Location, type, and description of vibration isolation devices.
- i. The safety system, including wiring schematics.
- j. One-line schematic and wiring diagrams of the generator, exciter, regulator, governor, and all instrumentation.
- k. Panel layouts.
- l. Mounting and support for each panel and major piece of electrical equipment.
- m. Engine-generator set rigging points and lifting instructions.

Acceptance; G, RE

Drawings which accurately depict the as-built configuration of the installation, upon acceptance of the diesel-generator set installation. Layout drawings shall be revised to reflect the as-built conditions and submitted with the as-built drawings.

SD-03 Product Data

Performance Tests;

Calculations of the engine and generator output power capability, including efficiency and parasitic load data.

Sound Limitations; G,

Sound power level data for the packaged unit operating at 100% load in a free field environment. The data should demonstrate compliance with the sound limitation requirements of this specification.

Generator; ,

Each generator KW rating and short circuit capacity (both symmetric and asymmetric).

Integral Main Fuel Storage Tank; , Day Tank; ,

Calculations for the capacity of each day tank, including allowances for recirculated fuel, usable tank capacity, and duration of fuel supply.

Power Factor; G,

Generator capability curve showing generator kVA output (kW vs. kvar) for both leading and lagging power factors ranging from 0 to 1.0.

Heat Rejected to Engine-Generator Space; ,

Manufacturers data to quantify heat rejected to the space with the engine generator set at rated capacity.

Time-Delay on Alarms; ,

The magnitude of monitored values which define alarm or action setpoints, and the tolerance (plus and/or minus) at which the device activates the alarm or action.

Cooling System; ,

a. The maximum and minimum allowable inlet temperatures of the coolant fluid.

b. The maximum allowable temperature rise in the coolant fluid through the engine.

c. The minimum allowable inlet fuel temperature.

Manufacturer's Catalog; ,

Manufacturer's standard catalog data describing and depicting each engine-generator set and all ancillary equipment in sufficient detail to demonstrate specification compliance.

Vibration Isolation; G,RE,

Vibration isolation system performance data for the range of frequencies generated by the engine-generator set during operation from no load to full load and the maximum vibration transmitted to the floor. Description of seismic qualification of the engine-generator mounting, base, and vibration isolation.

Instructions; G,RE,

Instructions including: the manufacturer's pre-start checklist and precautions; startup procedures for test mode, manual-start mode, and automatic-start mode, (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions. Instructions shall include procedures for interrelated equipment (such as heat recovery systems, co-generation, load-shedding, and automatic transfer switches). Instructions shall be weatherproof, laminated in plastic, framed, and posted where directed. Posted data shall include wiring and control diagrams showing the key mechanical and electrical control elements, and a diagrammatic layout of the system.

Experience; ,

Statement showing that each component manufacturer has a minimum of 3 years experience in the manufacture, assembly and sale of components used with stationary diesel-engine generator sets for commercial and industrial use.

Statement showing that the engine-generator set manufacturer/assembler has a minimum of 3 years experience in the manufacture, assembly and sale of stationary diesel engine-generator sets for commercial and industrial use.

Field Engineer;

A letter listing the qualifications, schools, formal training, and experience of the field engineer.

Site Welding; G,RE,

A letter listing the welder qualifying procedures for each welder, complete with supporting data such as test procedures used, what was tested to, and a list of the names of all welders and their qualifications symbols.

General Installation;

A complete copy of the manufacturer's installation procedures. A detailed description of the manufacturer's recommended break-in procedure.

Site Visit; ,

A site visit letter stating the date the site was visited and listing discrepancies found.

SD-06 Test Reports

Onsite Inspection and Tests; G,

a. A letter giving notice of the proposed dates of all onsite inspections and tests at least 14 days prior to beginning tests.

b. A detailed description of the Contractor's proposed procedures for onsite tests including the test including the test plan and a listing of equipment necessary to perform the tests. Submission shall be at least 14 days prior to beginning tests.

c. Six copies of the onsite test data described below in 8-1/2 x 11 inch 3-ring binders with a separate section for each test. Sections shall be separated by dividers with tabs. Data plots shall be full size 8-1/2 x 11 inches minimum), showing all grid lines, with full resolution.

(1) A description of the procedures for onsite tests.

(2) A list of equipment used, with calibration certifications.

(3) A copy of measurements taken, with required plots and graphs.

(4) The date of testing.

(5) The parameters verified.

(6) The condition specified for the parameter.

(7) The test results, signed and dated.

(8) A description of all adjustments made.

SD-07 Certificates

Vibration Isolation; G,RE,

Torsional analysis including prototype testing or calculations which certify and demonstrate that no damaging or dangerous torsional vibrations will occur when the prime mover is connected to the generator, at synchronous speeds, plus/minus 10%.

Prototype Tests; ,

Manufacturer's standard certification that prototype tests were performed for the generator model proposed.

Reliability and Durability; G,RE,

Documentation which cites engines and generators in similar service to demonstrate compliance with the requirements of this specification. Certification does not exclude annual technological improvements made by a manufacturer in the basic

standard model set on which experience was obtained, provided parts interchangeability has not been substantially affected and the current standard model meets all the performance requirements of this specification. For each different set, 2 like sets shall have performed satisfactorily in a stationary power application, independent and separate from the physical location of the manufacturer's and assembler's facilities, for a minimum of 2 consecutive years without any failure to start, including periodic exercise. The certification shall state that for the set proposed to meet this specification, there were no failures resulting in downtime for repairs in excess of 72 hours or any failure due to overheating during 2 consecutive years of service. Like sets are of the same model, speed, bore, stroke, number and configuration of cylinders, and output power rating. Like generators are of the same model, speed, pitch, cooling, exciter, voltage regulator and output power rating. A list shall be provided with the name of the installations, completion dates, and name and telephone number of a point of contact.

Emissions; G,RE,

A certification from the engine manufacturer stating that the engine exhaust emissions meet federal, state, and local regulations and restrictions specified. At a minimum, this certification shall include emission factors for criteria pollutants including nitrogen oxides, carbon monoxide, particulate matter, sulfur dioxide, non-methane hydrocarbon, and for hazardous air pollutants (HAPs).

Sound limitations; G,RE,

A certification from the manufacturer stating that the sound emissions meet the specification.

Flywheel Balance; RE,

Manufacturer's certification that the flywheel has been statically and dynamically balanced and is capable of being rotated at 125% of rated speed without vibration or damage.

Materials and Equipment; ,

A letter stating that where materials or equipment are specified to comply with requirements of UL, or other standards, written proof of such compliance has been obtained. The label or listing of the specified agency, or a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency are acceptable as proof.

Factory Inspection and Tests; ,

A certification that each engine generator set passed the factory tests and inspections and a list of the test and inspections.

Inspections; ,

A letter certifying that all facilities are complete and functional, that each system is fully functional, and that each item of equipment is complete, free from damage, adjusted, and ready for beneficial use.

Cooling System; ,

Certification that the engine-generator set and cooling system function properly in the ambient temperatures specified.

1.3 SYSTEM DESCRIPTION

Each engine-generator set shall be provided and installed complete and totally functional, with all necessary ancillary equipment to include air filtration; starting system; generator controls, protection, and isolation; instrumentation; lubrication; fuel system; cooling system; and engine exhaust system. Each engine generator set shall satisfy the requirements specified in the Engine Generator Parameter Schedule.

1.3.1 Engine-Generator Parameter Schedule

ENGINE GENERATOR PARAMETER SCHEDULE

| | |
|--|-----------------------------|
| Service Load | 15kW |
| Power Factor | 0.8lagging |
| Motor Starting kVA (maximum) | 6 kVA |
| Maximum Speed | 1800 rpm |
| Engine-Generator Application | stand-alone |
| Engine Cooling Type | water/ethylene glycol |
| Heat Exchanger Type | fin-tube |
| Governor Type | Droop |
| Frequency Regulation (droop) (No load to full load) | 3% (max.) |
| Frequency Bandwidth (steady state) | $\pm 0.4\%$ |
| Voltage Regulation (No load to full load) | $\pm 2\%$ (max.) |
| Voltage Bandwidth (steady state) | $\pm 2\%$ |
| Frequency | 60 Hz |
| Voltage | 208 volts (line to line) |
| Phases | 3 Phase, Wye |
| Minimum Generator | 0.6 percent Subtransient |

Reactance

| | |
|--|------------------------------------|
| Nonlinear Loads | 0 kVA |
| Max Step Load Increase | 100% of Service Load at 0.8 PF |
| Max Step Load Decrease (without shutdown) | 100 % of Service Load at 0.8 PF |
| Max Time to Start and be Ready to Assume Load | 10seconds |
| Max Allowable Heat Transferred Recommendations MBTUH/hr. To Engine Generator Space at Rated Output Capacity | Generator Manufacturer's |
| Max Summer Outdoor Temp (Ambient) | 92 degrees |
| Min Winter Outdoor Temp (Ambient) | 28 degrees |
| Installation Elevation | 4664 above sea level |

1.3.2 Output Capacity

Each generator set shall provide power equal to the sum of service load plus the machine's efficiency loss and associated ancillary equipment loads. Rated output capacity shall also consider engine and/or generator oversizing required to meet requirements in paragraph Engine-Generator Parameter Schedule.

1.3.3 Power Rating

Standby ratings shall be in accordance with EGSA 101P.

1.4 GENERAL REQUIREMENTS

1.4.1 Engine-Generator Set

Each set shall consist of one engine, one generator, and one exciter, mounted, assembled, and aligned on one base; and all other necessary ancillary equipment which may be mounted separately. Sets shall be assembled and attached to the base prior to shipping. Set components shall be environmentally suitable for the locations shown and shall be the manufacturer's standard product offered in catalogs for commercial or industrial use. A generator strip heater shall be provided for moisture control when the generator is not operating.

1.4.2 Nameplates

Each major component of this specification shall have the manufacturer's name, type or style, model or serial number, and rating number on a plate secured to the equipment. As a minimum, nameplates shall be provided for: Engines; Relays; Generators; Day tanks; Transformers (CT & PT); Regulators;

Pumps and pump motors; Governors; Generator Breaker; Economizers; Heat exchangers (other than base-mounted).

| | |
|---|-------------|
| Engines | Relays |
| Generators | Day tanks |
| Transformers (CT & PT) | Regulators |
| Pumps and pump motors | Governors |
| Generator Breaker | Economizers |
| Heat exchangers (other than base-mounted) | |

Where the following equipment is provided as a standard component by the diesel-engine generator set manufacturer, the nameplate information may be provided in the maintenance manual in lieu of nameplates.

| | |
|------------------|-----------|
| Battery charger | Heaters |
| Exhaust mufflers | Exciters |
| Switchgear | Silencers |
| Battery | |

1.4.3 Personnel Safety Device

Exposed moving parts, parts that produce high operating temperatures, parts which may be electrically energized, and parts that may be a hazard to operating personnel during normal operation shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. The safety devices shall be installed so that proper operation of the equipment is not impaired.

1.4.4 Verification of Dimensions

Before performing work, the premises shall be visited and details of the work verified. The Contracting Officer shall be advised in writing of any discrepancies before performing any work.

1.4.5 Conformance to Codes and Standards

Where equipment is specified to conform to requirements of any code or standard such as UL, the design, fabrication and installation shall conform to the code.

1.4.6 Site Welding

Structural members shall be welded in accordance with Section 05090A WELDING, STRUCTURAL. For all other welding, procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by a previously qualified employer may be accepted as permitted by ASME B31.1. Welder qualification tests shall be performed for each welder whose qualifications are not in compliance with the referenced standards. The Contracting Officer shall be notified 24 hours in advance of qualification tests. The qualification tests shall be performed at the work site if practical. The welder or welding operator shall apply the assigned personal symbol near each weld made as a permanent record

1.4.7 Engine Generator Set Enclosure

The engine generator set enclosure shall be corrosion resistant and fully weather resistant. The enclosure shall contain all set components and provide ventilation to permit operation at rated load under secured conditions. Doors shall be provided for access to all controls and equipment requiring periodic maintenance or adjustment. Removable panels shall be provided for access to components requiring periodic replacement. The enclosure shall be capable of being removed without disassembly of the engine-generator set or removal of components other than exhaust system. The enclosure shall reduce the noise of the generator set to within the limits specified in the paragraph SOUND LIMITATIONS.

1.4.8 Vibration Isolation

The maximum engine-generator set vibration in the horizontal, vertical and axial directions shall be limited to 6 mils (peak-peak RMS), with an overall velocity limit of RMS, for all speeds through 110% of rated speed.

The engine-generator set shall be provided with vibration-isolation in accordance with the manufacturer's standard recommendation. Where the vibration-isolation system does not secure the base to the structure floor or unit foundation, seismic restraints shall be provided in accordance with the seismic parameters specified.

1.4.9 Experience

Each component manufacturer shall have a minimum of 3 years experience in the manufacture, assembly and sale of components used with stationary diesel engine-generator sets for commercial and industrial use. The engine-generator set manufacture/assembler shall have a minimum of 3 years experience in the manufacture, assembly and sale of stationary diesel engine-generator sets for commercial and industrial use.

1.4.10 Field Engineer

The engine-generator set manufacturer or assembler shall furnish a qualified field engineer to supervise the complete installation of the engine-generator set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment. The field engineer shall have attended the engine-generator manufacturer's training courses on installation and operation and maintenance for engine generator sets.

1.4.11 Seismic Requirements

Seismic requirements shall be in accordance with Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT, 15070A SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT and 16070A

1.5 STORAGE AND INSTALLATION

The Contractor shall properly protect material and equipment in accordance with the manufacturers recommended storage procedures, before, during, and after installation. Stored items shall be protected from the weather and contamination. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.6 OPERATION AND MAINTENANCE MANUALS

The operation and maintenance manuals shall be submitted and approved prior to commencing onsite tests.

1.6.1 Operation Manual

Three copies of the manufacturers standard operation manual . The manual shall include:

- a. Step-by-step procedures for system startup, operation, and shutdown;
- b. Drawings, diagrams, and single-line schematics to illustrate and define the electrical, mechanical, and hydraulic systems with their controls, alarms, and safety systems;
- c. Procedures for interface and interaction with related systems to include automatic transfer switches .

1.6.2 Maintenance Manual

Three copies of the manufacturers standard maintenance manual .

- a. Procedures for each routine maintenance item. Procedures for troubleshooting. Factory-service, take-down overhaul, and repair service manuals, with parts lists.
- b. The manufacturer's recommended maintenance schedule.
- c. A component list which includes the manufacturer's name, address, type or style, model or serial number, rating, and catalog number for the major components listed in paragraph GENERAL REQUIREMENTS.
- d. A list of spare parts for each piece of equipment and a complete list of materials and supplies needed for operation.

1.7 SPECIAL TOOLS AND FILTERS

Two sets of special tools and two sets of filters required for maintenance shall be provided. Special tools are those that only the manufacturer provides, for special purposes, or to reach otherwise inaccessible parts. One handset shall be provided for each electronic governor when required to indicate and/or change governor response settings. Two complete sets of filters shall be supplied in a suitable storage box. these filters shall be in addition to filters replaced after testing.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be as specified.

2.1.1 Circuit Breakers, Low Voltage

NEMA AB 1, UL 489, and NEMA SG 3.

2.1.2 Filter Elements (Fuel-oil, Lubricating-oil, and Combustion-air)

Manufacturer's standard.

2.1.3 Instrument Transformers

ANSI C12.11.

2.1.4 Pipe (Sleeves, Fuel/Lube-oil, Compressed-Air, Coolant and Exhaust)

ASTM A 53/A 53M, ASTM A 106 or ASTM A 135, steel pipe. Pipe smaller than 2 inches shall be Schedule 80. Pipe 2 inches and larger shall be Schedule 40.

2.1.5 Pipe Flanges and Fittings

- a. Pipe Flanges and Flanged Fittings: ASTM A 181/A 181M, Class 60, or ASME B16.5, Grade 1, Class 150.
- b. Pipe Welding Fittings: ASTM A 234/A 234M, Grade WPB or WPC, Class 150, or ASME B16.11, 3000 lb.
- c. Threaded Fittings: ASME B16.3, Class 150.
- d. Valves: MSS SP-80, Class 150.
- e. Gaskets: Manufacturers Standard.

2.1.6 Pipe Hangers

MSS SP-58 and MSS SP-69.

2.1.7 Electrical Enclosures

2.1.7.1 General

NEMA ICS 6.

2.1.7.2 Panelboards

NEMA PB 1.

2.1.8 Electric Motors

Electric motors shall conform to the requirements of NEMA MG 1. Motors shall have sealed ball bearings, a maximum speed of 1800 rpm and integral automatic or manual reset thermal overload protectors. Motors used indoors shall have drip proof frames; those used outside shall be totally enclosed.

AC motors larger than 1/2 Hp shall be of the squirrel cage induction type for standard voltage of 200 volts, 60 Hz three phase power. AC motors 1/2 Hp or smaller, shall be for standard voltage 115 volts, 60 Hz, volts, single phase power.

2.1.9 Motor Controllers

Motor controllers and starters shall conform to the requirements of NFPA 70 and NEMA ICS 2.

2.2 ENGINE

Each engine shall operate on No. 2-D diesel conforming to ASTM D 975, shall be designed for stationary applications and shall be complete with ancilliaries. The engine shall be a standard production model described in the manufacturer's catalog. The engine shall be naturally aspirated,

scavenged, supercharged or turbocharged. The engine shall be two- or four-stroke-cycle and compression-ignition type. The engine shall be vertical inline, V-, or opposed-piston type, with a solid cast block or individually cast cylinders. The engine shall have a minimum of two cylinders. Opposed-piston type engines shall have no less than four cylinders. Each block shall have a coolant drain port. Each engine shall be equipped with an overspeed sensor.

2.3 FUEL SYSTEM

The fuel system for each engine generator set shall conform to the requirements of NFPA 30 and NFPA 37 and contain the following elements.

2.3.1 Pumps

2.3.1.1 Main Pump

Each engine shall be provided with an engine driven pump. The pump shall supply fuel at a minimum rate sufficient to provide the amount of fuel required to meet the performance indicated within the parameter schedule. The fuel flow rate shall be based on meeting the load requirements and all necessary recirculation.

2.3.1.2 Auxiliary Fuel Pump

Auxiliary fuel pumps shall be provided to maintain the required engine fuel pressure, either required by the installation or indicated on the drawings.

The auxiliary pump shall be driven by a dc electric motor powered by the starting/station batteries. The auxiliary pump shall be automatically actuated by a pressure detecting device.

2.3.2 Filter

A minimum of one full flow fuel filter shall be provided for each engine. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked.

2.3.3 Relief/Bypass Valve

A relief/bypass valve shall be provided to regulate pressure in the fuel supply line, return excess fuel to a return line, and prevent the build-up of excessive pressure in the fuel system.

2.3.4 Day Tank

Each engine shall be provided with a separate self-supporting day tank. Each day tank shall be provided with connections for fuel supply line, fuel return line, fuel overflow line, local fuel fill port, gauge, vent line, drain line, and float switch assembly for control. A fuel return line cooler shall be provided as recommended by the manufacturer and assembler. The temperature of the fuel returning to the day tank shall be below the flash point of the fuel. A temperature sensing device shall be installed in the fuel supply line. Each engine-generator set provided with weatherproof enclosures shall have its day tank mounted within the enclosure. The fuel fill line shall be accessible without opening the enclosure.

2.3.4.1 Capacity, Standby

Each day tank shall have capacity

2.3.4.2 Drain Line

Each day tank drain line shall be accessible and equipped with a shutoff valve. Self supporting day tanks shall be arranged to allow drainage into a 12 inch tall bucket.

2.3.4.3 Local Fuel Fill

Each local fuel fill port on the day tank shall be provided with a screw-on cap.

2.3.4.4 Fuel Level Controls

- a. Each day tank shall have a float-switch-assembly to perform the following functions:

- (3) Activate the "Overfill Fuel Level" alarm at 95% of the rated tank volume.

- (4) Activate the "Low Fuel Level" alarm at 70% of the rated tank Capacity.

- (5) Activate the automatic fuel supply shut-off valve located on the fill line of the day tank and shut down the fuel pump which supplies fuel to the day tank at 95% of the rated tank volume. The flow of fuel shall be stopped before any fuel can be forced into the fuel overflow line.

2.3.4.5 Arrangement

Self-supporting day tank shall either be arranged so that the fuel level in the day tank remains above the suction port of the engine driven fuel pump or be provided with a transfer pump to provide fuel to the engine driven pump. The overflow connection and fuel supply line shall be arranged so that the highest possible fuel level is below the fuel injectors.

2.4 LUBRICATION

Each engine shall have a separate lube-oil system conforming to NFPA 30 and NFPA 37. Each system shall be pressurized by engine-driven oil pumps. Each system shall be furnished with a relief valve for oil pressure regulation (for closed systems) and a dip-stick for oil level indications. The crankcase shall be vented in accordance with the manufacturer's recommendation except that it shall not be vented to the engine exhaust system. Crankcase breathers, if provided on engines installed in buildings or enclosures, shall be piped to vent to the outside. The system shall be readily accessible for service such as draining, refilling, etc. Each system shall permit addition of oil and have oil-level indication with the set operating. The system shall utilize an oil cooler as recommended by

the engine manufacturer.

2.4.1 Filter

One full-flow filter shall be provided for each pump. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked.

2.4.2 Lube-Oil Sensors

Each engine shall be equipped with lube-oil pressure sensors. Pressure sensors shall be located downstream of the filters and provide signals for required indication and alarms.

2.5 COOLING SYSTEM

Each engine cooling system shall operate automatically while the engine is running. Each cooling system shall be sized for the maximum summer outdoor design temperature and site elevation. Water-cooled system coolant shall use a combination of water and ethylene-glycol sufficient for freeze protection at the minimum winter outdoor temperature specified. The maximum temperature rise of the coolant across the engine shall be no more than that recommended and submitted in accordance with paragraph SUBMITTALS.

2.5.1 Coolant Pumps

Coolant pumps shall be the centrifugal type. Each engine shall have an engine-driven primary pump. Secondary pumps shall be electric motor driven and have automatic controllers.

2.5.2 Heat Exchanger

Each heat exchanger shall be of a size and capacity to limit the maximum allowable temperature rise in the coolant across the engine to that recommended and submitted in accordance with paragraph SUBMITTALS for the maximum summer outdoor design temperature and site elevation. Each heat exchanger shall be corrosion resistant, suitable for service in ambient conditions of application.

2.5.2.1 Fin-Tube-Type Heat Exchanger (Radiator)

Heat exchanger may be factory coated with corrosive resistant film providing that corrosion measures are taken to restore the heat rejection capability of the radiator to the initial design requirement via oversizing, or other compensating methods. Internal surfaces shall be compatible with liquid fluid coolant used. Materials and coolant are subject to approval by the Contracting Officer. Heat exchangers shall be pressure type incorporating a pressure valve, vacuum valve and a cap. Caps shall be designed for pressure relief prior to removal. Each heat exchanger and the entire cooling system shall be capable of withstanding a minimum pressure of 7 psi. Each heat exchanger shall be protected with a strong grille or screen guard. Each heat exchanger shall have at least two tapped holes. One tapped hole in the heat exchanger shall be equipped with a drain cock, the rest shall be plugged.

2.5.3 Ductwork

Ductwork shall be as specified in Section 16375 except that a flexible

connection shall be used to connect the duct to the diesel engine radiator. Material for the connection shall be wire-reinforced glass. The connection shall be rendered practically airtight.

2.5.4 Temperature Sensors

Each engine shall be equipped with coolant temperature sensors. Temperature sensors shall provide signals for pre-high and high indication and alarms.

2.6 AIR INTAKE EQUIPMENT

Filters and silencers shall be provided in locations that are convenient for servicing. The silencer shall be of the high-frequency filter type, located in the air intake system as recommended by the engine manufacturer. Silencer shall be capable of reducing the noise level at the air intake to a point below the maximum acceptable levels specified in paragraph SOUND LIMITATIONS. A combined filter-silencer unit meeting requirements for the separate filter and silencer items may be provided. Expansion elements in air-intake lines shall be copper.

2.7 EXHAUST SYSTEM

The system shall be separate and complete for each engine. Piping shall be supported so as to minimize vibration. Where a V-type engine is provided, a V-type connector with necessary flexible sections and hardware shall connect the engine exhaust outlets.

2.7.1 Flexible Sections and Expansion Joints

A flexible section at each engine and an expansion joint at each muffler shall be provided. Flexible sections and expansion joints shall have flanged connections. Flexible sections shall be made of convoluted seamless tube without joints or packing. Expansion joints shall be the bellows type. Expansion and flexible elements shall be stainless steel suitable for diesel-engine exhaust gas at the maximum exhaust temperature that is specified by the engine manufacturer. Expansion and flexible elements shall be capable of absorbing vibration from the engine and compensation for thermal expansion and contraction.

2.7.2 Exhaust Muffler

A chamber type exhaust muffler shall be provided. The muffler shall be constructed of welded steel and designed for outside mounting. Eyebolts, lugs, flanges, or other items shall be provided as necessary for support in the location and position indicated. Pressure drop through the muffler shall not exceed the recommendations of the engine manufacturer. Outside mufflers shall be zinc coated or painted with high temperature 400 degrees F resisting paint. The muffler and exhaust piping together shall reduce the noise level to less than the maximum acceptable level listed for sound limitations in paragraph SOUND LIMITATIONS. The muffler shall have a drain valve, nipple, and cap at the low-point of the muffler.

2.7.3 Exhaust Piping

Horizontal sections of exhaust piping shall be sloped downward away from the engine to a condensate trap and drain valve. Changes in direction shall be long-radius. Exhaust piping, mufflers and silencers installed inside any building shall be insulated in accordance with paragraph THERMAL

INSULATION and covered to protect personnel. Vertical exhaust piping shall be provided with a hinged, gravity operated, self-closing, rain cover.

2.8 EMISSIONS

The finished installation shall comply with Federal, state, and local regulations and restrictions regarding the limits of emissions.,

2.9 STARTING SYSTEM

The starting system for standby engine generator sets used in emergency applications shall be in accordance with NFPA 99 and NFPA 110 and as follows.

2.9.1 Controls

An engine control switch shall be provided with functions including: run/start (manual), off/reset, and automatic mode. Start-stop logic shall be provided for adjustable cycle cranking and cool down operation. The logic shall be arranged for manual starting and fully automatic starting in accordance with paragraph AUTOMATIC ENGINE-GENERATOR SET SYSTEM OPERATION. Electrical starting systems shall be provided with an adjustable cranking limit device to limit cranking periods from 1 second up to the maximum duration.

2.9.2 Capacity

The starting system shall be of sufficient capacity, at the maximum outdoor summer temperature specified to crank the engine without damage or overheating. The system shall be capable of providing a minimum of three cranking periods with 15-second intervals between cranks. Each cranking period shall have a maximum duration of 15 seconds.

2.9.3 Functional Requirements

Starting system shall be manufacturers recommended dc system utilizing a negative circuit ground. Starting motors shall be in accordance with SAE ARP892.

2.9.4 Battery

A starting battery system shall be provided and shall include the battery, battery rack, intercell connectors, and spacers. The battery shall be in accordance with SAE J537. Critical system components (rack, protection, etc.) shall be sized to withstand the seismic acceleration forces specified. The battery shall be lead-acid or nickel-cadmium type, with sufficient capacity, at the minimum outdoor winter temperature specified to provide the specified cranking periods. Valve-regulated lead-acid batteries are not acceptable.

2.9.5 Battery Charger

A current-limiting battery charger, conforming to UL 1236, shall be provided and shall automatically recharge the batteries. The charger shall be capable of an equalize charging rate for recharging fully depleted batteries within 24 hours and a float charge rate for maintaining the batteries in prime starting condition. An ammeter shall be provided to

indicate charging rate. A timer shall be provided for the equalize charging rate setting. A battery is considered to be fully depleted when the output voltage falls to a value which will not operate the engine generator set and its components.

2.9.6 Starting Aids

The manufacturer shall provide one or more of the following methods to assist engine starting.

2.9.6.1 Glow Plugs

Glow plugs shall be designed to provide sufficient heat for combustion of fuel within the cylinders to guarantee starting at an ambient temperature of minus 25 degrees F.

2.9.6.2 Jacket-Coolant Heaters

A thermostatically controlled electric heater shall be mounted in the engine coolant jacketing to automatically maintain the coolant within plus or minus 3 degrees of the control temperature. The heater shall operate independently of engine operation so that starting times are minimized. The control temperature shall be the temperature recommended by the engine manufacturer to meet the starting time specified.

2.10 GOVERNOR

Each engine shall be provided with a governor which maintains the frequency within a bandwidth of the rated frequency, over a steady-state load range of zero to 100% of rated output capacity. The governor shall be configured for safe manual adjustment of the speed/frequency during operation of the engine generator set, without special tools, from 90 to 110 % of the rated speed/frequency, over a steady state load range of zero to 100% of rated capacity. Droop governors shall maintain the midpoint of the frequency bandwidth linearly for steady-state loads over the range of zero to 100% of rated output capacity, with 3% droop.

2.11 GENERATOR

Each generator shall be of the synchronous type, one or two bearing, conforming to NEMA MG 1, equipped with winding terminal housings in accordance with NEMA MG 1, equipped with an amortisseur winding, and directly connected to the engine. Insulation shall be Class F. Generator design shall protect against mechanical, electrical and thermal damage due to vibration, 25 percent overspeeds, or voltages and temperatures at a rated output capacity of 100 percent. Generator ancillary equipment shall meet the short circuit requirements of NEMA MG 1. Frames shall be the drip-proof type.

2.11.1 Current Balance

At 100 percent rated load, and load impedance equal for each of the three phases, the permissible current difference between any two phases shall not exceed 2 percent of the largest current on either of the two phases.

2.11.2 Voltage Balance

At any balanced load between 75 and 100 percent of rated load, the difference in line-to-neutral voltage among the three phases shall not

exceed 1 percent of the average line-to-neutral voltage. For a single-phase load condition, consisting of 25 percent load at unity power factor placed between any phase and neutral with no load on the other two phases, the maximum simultaneous difference in line-to-neutral voltage between the phases shall not exceed 3 percent of rated line to neutral voltage. The single-phase load requirement shall be valid utilizing normal exciter and regulator control. The interpretation of the 25 percent load for single phase load conditions means 25 percent of rated current at rated phase voltage and unity power factor.

2.11.3 Waveform

The deviation factor of the line-to-line voltage at zero load and at balanced full rated load at 0.8 power factor shall not exceed 10%. The RMS of all harmonics shall be less than 5.0% and that of any one harmonic less than 3.0% at full rated load. Each engine-generator shall be designed and configured to meet the total harmonic distortion limits of IEEE Std 519.

2.12 EXCITER

The generator exciter shall be of the brushless type. Semiconductor rectifiers shall have a minimum safety factor of 300% for peak inverse voltage and forward current ratings for all operating conditions, including 110% generator output at 104 degrees F ambient. The exciter and regulator in combination shall maintain generator-output voltage within the limits specified.

2.13 VOLTAGE REGULATOR

Each generator shall be provided with a solid-state voltage regulator, separate from the exciter. The regulator shall maintain the voltage within a bandwidth of the rated voltage, over a steady-state load range of zero to 100% of rated output capacity. Regulator shall be configured for safe manual adjustment of the engine generator voltage output without special tools, during operation from 90 to 110% of the rated voltage over the steady state load range of zero to 100% of rated output capacity. Regulation drift shall not exceed plus or minus 0.5% for an ambient temperature change of 36 degrees F.

2.13.1 Steady State Performance (Regulation or Voltage Droop).

The voltage regulator shall have a maximum droop of 2% of rated voltage over a load range from 0 to 100% of rated output capacity and automatically maintain the generator output voltage within the specified operational bandwidth.

2.14 GENERATOR PROTECTION

Short circuit and overload protection for the generator shall be provided. The generator circuit breaker (IEEE Device 52) ratings shall be consistent with the generator rated voltage and frequency, with continuous, short circuit and interrupting current ratings to match the generator capacity. The manufacturer shall determine the short circuit current interrupting rating of the breaker. The breaker shall be engine generator base mounted by the engine-generator set manufacturer. Molded case breakers shall be provided with shunt trip. Surge protection shall be provided for each phase of the generator, to be mounted at the generator terminals.

2.14.1 Panelboards

Panelboards shall be metal-enclosed, general purpose, 3-phase, 4-wire, , 240 volt rated, with neutral bus and continuous ground bus, conforming to NEMA PB 1 and UL 891. Neutral bus and ground bus capacity shall be full capacity.

Enclosure designs, construction, materials and coatings shall be suitable for the application and environment. Bus continuous current rating shall be at least equal to the generator rating and correspond to UL listed current ratings specified for panelboards and switchboards. Current withstand rating (short circuit rating) shall match the generator capacity. Buses shall be copper.

2.14.2 Devices

Switches, circuit breakers, switchgear, fuses, relays, and other protective devices shall be as specified in Section 16475A COORDINATED POWER SYSTEM PROTECTION.

2.15 SAFETY SYSTEM

Devices, wiring, remote panels, local panels, etc., shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions. The safety system shall be provided with a self-test method to verify its operability. Alarm signals shall have manual acknowledgement and reset devices. The alarm signal systems shall reactivate for new signals after acknowledgment is given to any signal. The systems shall be configured so that loss of any monitoring device shall be dealt with as an alarm on that system element.

2.15.1 Audible Signal

The audible alarm signal shall sound at a frequency of 70 Hz at a volume of 75 dB at 10 feet. The sound shall be continuously activated upon alarm and silenced upon acknowledgment. Signal devices shall be located as shown.

2.15.2 Visual Signal Signal

The visual alarm signal shall be a panel light. The light shall be normally off, activated to be blinking upon alarm. The light shall change to continuously light upon acknowledgment. If automatic shutdown occurs, the display shall maintain activated status to indicate the cause of failure and shall not be reset until cause of alarm has been cleared and/or restored to normal condition. Shutdown alarms shall be red; all other alarms shall be amber.

2.15.3 Alarms and Action Logic

2.15.3.1 Shutdown

Simultaneous activation of the audible signal, activation of the visual signal, stopping the engine, and opening the generator main circuit breakers shall be accomplished.

2.15.3.2 Problem

Activation of the visual signal shall be accomplished.

2.15.4 Local Alarm Panel

A local alarm panel shall be provided with the following shutdown and alarm

functions in accordance with NFPA 110 level 1 and including the listed Corps of Engineers requirements, mounted either on or adjacent to the engine generator set.

| Device/ Condition/ Function | What/Where/Size | NFPA 99 | NFPA 110 Level 1 | NFPA 110 Level 2 | Corps of Engrs Required |
|--|--|----------|---------------------|---------------------|-------------------------------|
| Shutdowns W/Alarms | | | | | |
| High engine temperature | Automatic/ jacket water/ cylinder | SD/CP VA | SD/CP VA | SD/CP VA | SD VA |
| Low lube-oil pressure | Automatic/ pressure/ level | SD/CP VA | SD/CP VA | SD/CP VA | SD VA |
| Overspeed shutdown \$ alarm | (110% (+ 2%) of rated speed | SD/CP VA | SD/CP VA | SD/CP VA | SD VA |
| Overcrank failure to start | Automatic/ Failure to to start | SD/CP VA | SD/CP VA | SD/CP VA | |
| Air shutdown damper (200-600kW) | When used | | SD/CP VA | SD/CP VA | |
| Day tank overflow limit indication & transfer pump shutdown (95% volume) | Automatic/Day Tank/Level | | | | SD/OPA (Pump) |
| Red emergency stop switch | Manual Switch | | SD/CP VA | SD/CP VA | SD VA |
| Failure to crank | Corps of Engrs. Required | | | | |
| Integral Main Fuel Tank low fuel limit Device/ Condition/ indication (70% volume remaining) | Corps of Engrs. Required | | | | |
| Alarms | | | | | |
| Low lube-oil | Pressure/ | CP VA | CP VA | CP VAO | CP VA |

| Device/ Condition/ Function pressure | What/Where/Size level | NFPA 99 | NFPA 110 Level 1 | NFPA 110 Level 2 | Corps of Engrs Required |
|---|---|---------|---------------------|---------------------|-------------------------------|
| Low fuel level | Main tank, 3 hours remaining | VA/AA | CP VA | CP VAO | |
| High fuel level | Integral Main Fuel Storage Tank 95% Volume | | | | CP VA |
| Low coolant | Jacket water | CP/VA | CP VA | CP VA | |
| Pre-high temperature | Jacket water/ cylinder | CP VA | CP VA | CP VAO | CP VA |
| Pre-low lube-oil pressure | | CP VA | | | CP VA |
| High battery voltage | | | CP VA | CP VAO | |
| Low battery voltage | | | CP VA | CP VAO | |
| Battery charger AC failure | AC supply not available | | CP VA | CP VAO | |
| Control switch not in AUTO | | | CP VA | CP VAO | |
| Low starting air pressure | | | CP VA | CP VAO | |
| Low starting hydraulic pressure | | | CP VA | CP VAO | |

SD - Shut Down

CP - On Control Panel

VA - Visual Alarm

AA - Audible Alarm

O - Optional

2.15.5 Time-Delay on Alarms

For startup of the engine-generator set, time-delay devices shall be installed bypassing the low lubricating oil pressure alarm during cranking, and the coolant-fluid outlet temperature alarm. The lube-oil time-delay device shall return its alarm to normal status after the engine starts. The coolant time-delay device shall return its alarm to normal status 5 minutes after the engine starts.

2.16 ENGINE GENERATOR SET CONTROLS AND INSTRUMENTATION

Devices, wiring, remote panels, local panels, etc., shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions.

2.16.1 Controls

A local control panel shall be provided with controls in accordance with NFPA 110 level 1 and as follows mounted either on or adjacent to the engine generator set.

| Device/Condition/ Function | Corps Requirement | NFPA 110 Level 1 | NFPA 110 Level 2 | MFG Offering |
|---|-------------------|---------------------|---------------------|-----------------|
| Controls | | | | |
| Switch: run/start - off/set - auto | CP | | | CP/STD |
| Emergency stop switch & alarm | CP | | | CP/STD |
| Lamp test/indicator test | CP | CP VA | CP VA | CP/STD |
| Common alarm contacts/ fault relay | | X | X | CP/O |
| Panel lighting | CP | | | CP/STD |
| Audible alarm & silencing/reset switch | CP | | | |
| Voltage adjust for voltage Regulator | CP | | | CP/STD |
| Pyrometer display w/selector switch | CP | | | |
| Remote emergency stop switch | | CP VA | CP VA | |
| Remote fuel shutoff switch | | | | |
| Remote lube-oil shutoff switch | | | | |

2.16.2 Engine Generator Set Metering and Status Indication

A local panel shall be provided with devices in accordance with NFPA 110 level 1 and as follows mounted either on or adjacent to the engine generator set .

| Device/Condition/ Function | Corps Requirement | NFPA 110 Level 1 | NFPA 110 Level 2 | MFG Offering |
|-------------------------------|-------------------|---------------------|---------------------|-----------------|
| Genset Status & Metering | | | | |
| Genset supplying load | | CP VA | CP VAO | CP VAO |
| System ready | | | | CP/STD |
| Engine oil pressure | CP | | | CP/STD |
| Engine coolant temperature | CP | | | CP/STD |
| Engine RPM (Tachometer) | CP | | | CP/STD |

| Device/Condition/ Function | Corps Requirement | NFPA 110 Level 1 | NFPA 110 Level 2 | MFG Offering |
|---|-------------------|---------------------|---------------------|-----------------|
| Engine run hours | CP | | | CP/STD |
| Pyrometer display w/selector switch | CP | | | |
| AC volts (generator), 3-phase | CP | | | CP/STD |
| AC amps (generator), 3-phase | CP | | | CP/STD |
| Generator frequency | CP | | | CP/STD |
| Phase selector switches (amps & volts) | CP | | | CP/STD |
| Watts/kW | | | | CP/VA-O |
| Voltage Regulator Adjustment | CP | | | |

CP - On Control Panel

VA - Visual Alarm

AA - Audible Alarm

O - Optional

STD - Manufacturers Standard Offering

2.17 PANELS

Each panel shall be of the type necessary to provide specified functions. Panels shall be mounted on the engine generator set base by vibration/shock absorbing type mountings. Instruments shall be mounted flush or semiflush.

Convenient access to the back of instruments shall be provided to facilitate maintenance. Instruments shall be calibrated using recognized industry calibration standards. Each panel shall be provided with a panel identification plate which clearly identifies the panel function as indicated. Each instrument and device on the panel shall be provided with a plate which clearly identifies the device and its function as indicated. Panels except the remote alarm panel can be combined into a single panel.

2.17.1 Enclosures

Enclosures shall be designed for the application and environment, conforming to NEMA ICS 6, and provided with locking mechanisms which are keyed alike.

2.17.2 Analog

Analog electrical indicating instruments shall be in accordance with ANSI C39.1 with semiflush mounting. Switchgear, and control-room panel-mounted instruments shall have 250 degree scales with an accuracy of not less than 1 percent. Unit-mounted instruments shall be the manufacturer's standard with an accuracy of not less than 2 percent. The instrument's operating temperature range shall be minus 20 to plus 65 degrees C. Distorted generator output voltage waveform of a crest factor less than 5 shall not affect metering accuracy for phase voltages, hertz and amps.

2.17.3 Electronic

Electronic indicating instruments shall be true RMS indicating, 100 percent solid state, microprocessor controlled to provide all specified functions. Control, logic, and function devices shall be compatible as a system, sealed, dust and water tight, and shall utilize modular components with metal housings and digital instrumentation. An interface module shall be provided to decode serial link data from the electronic panel and translate alarm, fault and status conditions to set of relay contacts. Instrument accuracy shall be not less than 2 percent for unit mounted devices and 1 percent for control room, panel mounted devices, throughout a temperature range of minus 20 to plus 65 degrees C. Data display shall utilize LED or back lit LCD. Additionally, the display shall provide indication of cycle programming and diagnostic codes for troubleshooting. Numeral height shall be 1/2 inch.

2.17.4 Parameter Display

Indication or readouts of the lubricating-oil pressure, ac voltmeter, ac ammeter, frequency meter, and coolant temperature.

2.17.5 Exerciser

The exerciser shall be in accordance with Section 16410A AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH.

2.18 SURGE PROTECTION

Electrical and electronic components shall be protected from, or designed to withstand the effects of surges from switching and lightning.

2.19 AUTOMATIC ENGINE-GENERATOR-SET SYSTEM OPERATION

Fully automatic operation shall be provided for the following operations: engine-generator set starting and source transfer upon loss of normal source; retransfer upon restoration of the normal source; sequential starting; and stopping of each engine-generator set after cool down. Devices shall automatically reset after termination of their function.

2.19.1 Automatic Transfer Switch

Automatic transfer switches shall be in accordance with Section 16410A AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH.

2.19.2 Monitoring and Transfer

Devices shall be provided to monitor voltage and frequency for the normal power source and each engine generator set, and control transfer from the normal source and retransfer upon restoration of the normal source. Functions, actuation, and time delays shall be as described in Section 16410A AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH.

2.20 MANUAL ENGINE-GENERATOR SET SYSTEM OPERATION

Complete facilities shall be provided for manual starting and testing of each set without load, loading and unloading of each set.

2.21 BASE

The base shall be constructed of steel. The base shall be designed to rigidly support the engine-generator set, ensure permanent alignment of all rotating parts, be arranged to provide easy access to allow changing of lube-oil, and ensure that alignment will be maintained during shipping and normal operation. The base shall permit skidding in any direction during installation and shall be provided with suitable holes for foundation bolts. The base shall also withstand and mitigate the effects of synchronous vibration of the engine and generator, and shall be provided with suitable holes for anchor bolts and jacking screws for leveling.

2.22 THERMAL INSULATION

Thermal insulation shall be as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.23 PAINTING AND FINISHING

The engine-generator set shall be cleaned, primed and painted in accordance with the manufacturer's standard color and practice.

2.24 FACTORY INSPECTION AND TESTS

Factory inspection and tests shall be performed on each engine-generator set proposed to meet this specification section. Inspections shall be completed and necessary repairs made prior to testing. Inspectors shall look for leaks, looseness, defects in components, and proper assembly. Factory tests shall be NEMA MG 1 routine tests and the manufacturers routine tests.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

Installation shall provide clear space for operation and maintenance in accordance with NFPA 70 and IEEE C2. Installation of pipe, duct, conduit, and ancillary equipment shall be configured to facilitate easy removal and replacement of major components and parts of the engine-generator set.

3.2 PIPING INSTALLATION

3.2.1 General

Piping shall be welded. Connections at valves shall be flanged. Connections at equipment shall be flanged except that connections to the diesel engine may be threaded if the diesel-engine manufacturer's standard connection is threaded. Except as otherwise specified, flanged fittings shall be utilized to allow for complete dismantling and removal of each piping system from the facility without disconnecting or removing any portion of any other system's equipment or piping. Connections to all equipment shall be made with flexible connectors. Pipes extending through the roof shall be properly flashed. Piping shall be installed clear of windows, doors, and openings to permit thermal expansion and contraction without damage to joints or hangers, and with a 1/2 inch drain valve at each low point.

3.2.2 Supports

Hangers, inserts, and supports shall be of sufficient size to accommodate any insulation and shall conform to MSS SP-58 and MSS SP-69. Supports

shall be spaced not more than 7 feet on center for pipes 2 inches in diameter or less, not more than 12 feet on center for pipes larger than 2 inches but no larger than 4 inches, and not more than 17 feet on center for pipes larger than 4 inches in diameter. Supports shall be provided at pipe bends or change of direction.

3.2.2.1 Ceiling and Roof

Exhaust piping shall be supported with appropriately sized type 41 single pipe roll and threaded rods; all other piping shall be supported with appropriately sized type 1 clevis and threaded rods.

3.2.2.2 Wall

Wall supports for pipe shall be made by suspending the pipe from appropriately sized type 33 brackets with the appropriate ceiling and roof pipe supports.

3.2.3 Flanged Joints

Flanges shall be 125 pound type, drilled, and of the proper size and configuration to match equipment and diesel-engine connections. Gaskets shall be factory cut in one piece 1/16 inch thick.

3.2.4 Cleaning

After fabrication and before assembly, piping interiors shall be manually wiped clean of all debris.

3.2.5 Pipe Sleeves

Pipes passing through construction such as ceilings, floors, or walls shall be fitted with sleeves. Each sleeve shall extend through and be securely fastened in its respective structure and shall be cut flush with each surface. The structure shall be built tightly to the sleeve. The inside diameter of each sleeve shall be 1/2 inch, and where pipes pass through combustible materials, 1 inch larger than the outside diameter of the passing pipe or pipe covering.

3.3 ELECTRICAL INSTALLATION

Electrical installation shall comply with NFPA 70, IEEE C2, and Section 16415A ELECTRICAL WORK, INTERIOR.

3.3.1 Vibration Isolation

Flexible fittings shall be provided for all conduit, cable trays, and raceways attached to engine-generator sets. Metallic conductor cables installed on the engine generator set and from the engine generator set to equipment not mounted on the engine generator set shall be flexible stranded conductor. Terminations of conductors on the engine generator set shall be crimp-type terminals or lugs.

3.4 FIELD PAINTING

Field painting shall be as specified in Section 09900 PAINTS AND COATINGS.

3.5 ONSITE INSPECTION AND TESTS

3.5.1 Test Conditions

3.5.1.1 Data

Measurements shall be made and recorded of parameters necessary to verify that each set meets specified parameters. If the results of any test step are not satisfactory, adjustments or replacements shall be made and the step repeated until satisfactory results are obtained. Unless otherwise indicated, data shall be taken during engine-generator set operation and recorded in 15 minute intervals and shall include: readings of engine-generator set meters and gauges for electrical and power parameters; oil pressure; ambient temperature; and engine temperatures available from meters and gauges supplied as permanent equipment on the engine-generator set. In the following tests where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings. Electrical measurements shall be performed in accordance with IEEE Std 120. Definitions and terms are in accordance with IEEE Std 100. Temperature limits in the rating of electrical equipment and for the evaluation of electrical insulation shall be in accordance with IEEE Std 1.

3.5.1.2 Power Factor

Engine-generator set operating tests shall be made utilizing a load with a .8 power factor.

3.5.1.3 Contractor Supplied Items

The Contractor shall provide all equipment and supplies required for inspections and tests including fuel, test instruments, and loadbanks at the specified power factors.

3.5.1.4 Instruments

Readings of panel gauges, meters, displays, and instruments, provided under this specification shall be verified during test runs by test instruments of precision and accuracy greater than the tested items. Test instrument accuracy shall be at least as follows: current, 1.5%; voltage, 1.5%; real power, 1.5%; reactive power, 1.5%; power factor, 3%; frequency, 0.5%. Test instruments shall be calibrated by a recognized standards laboratory within 30 days prior to testing.

3.5.1.5 Sequence

The sequence of testing shall be as specified in the approved testing plan unless variance is authorized by the Contracting Officer. Field testing shall be performed in the presence of the Contracting Officer. Tests may be scheduled and sequenced in order to optimize run-time periods; however the following general order of testing shall be followed: Construction Tests; Inspections; Safety run Tests; and Performance Tests and Final Inspection.

3.5.2 Construction Tests

Individual component and equipment functional tests for fuel piping, coolant piping, and lubricating-oil piping, electrical circuit continuity, insulation resistance, circuit protective devices, and equipment not

provided by the engine-generator set manufacturer shall be performed prior to connection to the engine-generator set.

3.5.2.1 Piping Test

- a. Lube-oil and fuel-oil piping shall be flushed with the same type of fluid intended to flow through the piping, until the outflowing fluid has no obvious sediment or emulsion.
- b. Fuel piping which is external to the engine-generator set shall be tested in accordance with NFPA 30. All remaining piping which is external to the engine generator set shall be pressure tested with air pressure at 150% of the maximum anticipated working pressure, but in no case less than 150 psig, for a period of 2 hours to prove the piping has no leaks. If piping is to be insulated, the test shall be performed before the insulation is applied.

3.5.2.2 Electrical Equipment Tests

- a. Low-voltage cable insulation integrity tests shall be performed for cables connecting the generator breaker to the automatic transfer switch. Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

$R \text{ in megohms} = (\text{rated voltage in kV} + 1) \times 304,800 / (\text{length of cable in meters}).$

$(R \text{ in megohms} = (\text{rated voltage in kV} + 1) \times 1000 / (\text{length of cable in feet}))$

Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

- c. Ground-Resistance Tests. The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.
 - 1) Single rod electrode - ohms.
 - 2) Multiple rod electrodes - 25 ohms.
 - 3) Ground mat - ohms.
- d. Circuit breakers and switchgear shall be examined and tested in

accordance with manufacturer's published instructions for functional testing.

3.5.3 Inspections

The following inspections shall be performed jointly by the Contracting Officer and the Contractor, after complete installation of each engine-generator set and its associated equipment, and prior to startup of the engine-generator set. Checks applicable to the installation shall be performed. The results of those which are physical inspections (I) shall be documented by the Contractor and submitted in accordance with paragraph SUBMITTALS. The Contractor shall present manufacturer's data for the inspections designated (D) at the time of inspection. Inspections shall verify that equipment type, features, accessibility, installation and condition are in accordance with the contract specification. Manufacturer's statements shall certify provision of features which cannot be verified visually.

1. Drive belts. (I)
2. Governor type and features. (I)
3. Engine timing mark. (I)
4. Starting motor. (I)
5. Starting aids. (I)
6. Coolant type and concentration. (D)
7. Radiator drains. (I)
8. Block coolant drains. (I)
9. Coolant fill level. (I)
10. Coolant line connections. (I)
11. Coolant hoses. (I)
12. Combustion air filter. (I)
13. Intake air silencer. (I)
14. Lube oil type. (D)
15. Lube oil drain. (I)
16. Lube-oil filter. (I)
17. Lube-oil-fill level. (I)
18. Lube-oil line connections. (I)
19. Lube-oil lines. (I)
20. Fuel type. (D)
21. Fuel-level. (I)
22. Fuel-line connections. (I)
23. Fuel lines. (I)
24. Fuel filter. (I)
25. Access for maintenance. (I)
26. Voltage regulator. (I)
27. Battery-charger connections. (I)
28. Wiring & terminations. (I)
29. Instrumentation. (I)
30. Hazards to personnel. (I)
31. Base. (I)
32. Nameplates. (I)
33. Paint. (I)
34. Exhaust system. (I)
35. Access provided to controls. (I)
36. Enclosure. (I)
37. Engine & generator mounting bolts (proper application). (I)

3.5.4 Safety Run Tests

- a. Perform and record engine manufacturer's recommended prestarting

checks and inspections.

- b. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.
- c. Activate the manual emergency stop switch and verify that the engine stops.
- d. Remove the high and pre-high lubricating oil temperature sensing elements from the engine and temporarily install temperature gauge in their normal locations on the engine (required for safety, not for recorded data). Where necessary, provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.
- e. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set at no load until the output voltage and frequency stabilize. Monitor the temporarily installed temperature gauges. If temperature reading exceeds the value for an alarm condition, activate the manual emergency stop switch.
- f. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.
- g. Remove the high and pre-high coolant temperature sensing elements from the engine and temporarily seal their normal location on the engine and temporarily install temperature gauges in their normal locations on the engine (required for safety, not for recorded data). Where necessary provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.
- h. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set at no load until the output voltage and frequency stabilize.
- i. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.
- j. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.
- k. Operate the engine generator-set for at least 30 minutes at 100 percent of service load.
- l. Verify proper operation of the governor and voltage regulator.
- m. Verify proper operation and setpoints of gauges and instruments.
- n. Verify proper operation of ancillary equipment.

- o. Manually adjust the governor to increase engine speed past the overspeed limit. Record the RPM at which the engine shuts down.
- p. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75 percent of rated load.
- q. Manually fill the day tank to a level above the overfill limit. Record the level at which the overfill alarm sounds. Verify shutdown of the fuel transfer pump. Drain the day tank down below the overfill limit.
- r. Shut down the engine. Remove the time-delay low lube oil pressure alarm bypass and try to start the engine. Record the results.
- s. Attach a manifold to the engine oil system (at the oil sensor pressure port) that contains a shutoff valve in series with a connection for the engine's oil pressure sensor followed by an oil pressure gauge ending with a bleed valve. The engine's oil pressure sensor shall be moved from the engine to the manifold and its normal location on the engine temporarily sealed. The manifold shutoff valve shall be open and bleed valve closed.
- t. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75 percent of service load.
- u. Close the manifold shutoff valve. Slowly allow the pressure in the manifold to bleed off through the bleed valve while watching the pressure gauge. Record the pressure at which the engine shuts down. Catch oil spillage from the bleed valve in a container. Add the oil from the container back to the engine, remove the manifold, and reinstall the engine's oil pressure sensor on the engine.
- v. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 100% of service load. Record the maximum sound level in each frequency band at a distance of 75 feet from the end of the exhaust and air intake piping directly along the path of intake and discharge horizontal piping; or at a radius of 75 feet from the engine at 45 degrees apart in all directions for vertical piping. The measurements should comply with the paragraph SOUND LIMITATIONS. If a sound limiting enclosure is not provided, the muffler and air intake silencer shall be modified or replaced as required to meet the sound limitations of this specification. If the sound limitations can not be obtained by modifying or replacing the muffler and air intact silencer, the contractor shall notify the Contracting Officer and provide a recommendation for meeting the sound limitations.
- w. Manually drain off fuel slowly from the day tank to empty it to below the low fuel level limit and record the level at which the audible alarm sounds. Add fuel back to the day tank to fill it above low level alarm limits.

3.5.5 Performance Tests

3.5.5.1 Continuous Engine Load Run Test

The engine-generator set and ancillary systems shall be tested at service load to: demonstrate durability; verify that heat of extended operation does not adversely affect or cause failure in any part of the system; and check all parts of the system. If the engine load run test is interrupted for any reason, the entire test shall be repeated. The engine load run test shall be accomplished principally during daylight hours, with an average ambient temperature of 92 degrees F. After each change in load in the following test, measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the allowable range. Measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.). Stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings. Data taken at 15 minutes intervals shall include the following:

a. Electrical: Output amperes, voltage, real and reactive power, power factor, frequency.

b. Pressure: Lube-oil.

c. Temperature: Coolant.
Lube-oil.
Ambient.

(1) Perform and record engine manufacturer's recommended prestarting checks and inspections. Include as a minimum checking of coolant fluid, fuel, and lube-oil levels.

(2) Start the engine; make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

(3) Operate the engine generator-set for at least 2 hours at 75 percent of service load.

(4) Increase load to 100% of service load and operate the engine generator-set for at least 2 hours.

(5) Remove load from the engine-generator set.

3.5.5.2 Load Acceptance Test

Engine manufacturer's recommended prestarting checks and inspections shall be performed and recorded. The engine shall be started, and engine manufacturer's after-starting checks and inspections made and recorded during a reasonable warm-up period. For the following steps, the output line-line and line-neutral voltages and frequency shall be recorded after performing each step instruction (after stabilization of voltage and frequency). Stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings.

- a. Apply load in steps no larger than the Maximum Step Load Increase to load the engine-generator set to 100 of Service Load.
- b. Verify that the engine-generator set responds to the load addition and that the output voltage returns to and stabilizes within the rated bandwidths.

3.5.6 Automatic Operation Tests for Stand-Alone Operation

The automatic loading system shall be tested to demonstrate automatic starting, of each engine-generator set. The loads for this test shall utilize the actual loads to be served, and the loading sequence shall be the indicated sequence. Perform this test for a minimum of two successive, successful tests. Data taken shall include the following:

- a. Ambient temperature (at 15 minute intervals).
- b. Generator output current (before and after load changes).
- c. Generator output voltage (before and after load changes).
- d. Generator output frequency (before and after load changes.)
 1. Initiate loss of the primary power source and verify automatic sequence of operation.
 2. Restore the primary power source and verify sequence of operation.
 3. Verify resetting of controls to normal.

3.6 FINAL INSPECTION AND TESTING

- a. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.
- b. Increase the load in steps no greater than the maximum step load increase to 100% of service load, and operate the engine-generator set for at least 30 minutes. Measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the same range as previous measurements and is within the required range.
- c. Remove load and shut down the engine-generator set after the recommended cool down period. Perform the pre-test inspections and take necessary corrective actions.
- d. Remove the lube oil filter and have the oil and filter examined by the engine manufacturer for excessive metal, abrasive foreign particles, etc. Any corrective action shall be verified for effectiveness by running the engine for 4 hours at service load, then re-examining the oil and filter.
- e. Remove the fuel filter and examine the filter for trash, abrasive foreign particles, etc.
- f. Visually inspect and check engine and generator mounting bolts for

tightness and visible damage.

g. Replace air, oil, and fuel filters with new filters.

3.7 MANUFACTURER'S FIELD SERVICE

3.7.1 Onsite Training

The Contractor shall conduct training course for operating staff as designated by the Contracting Officer. The training period shall consist of a total 4 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance. The course instructions shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations such as oil change, oil filter change, and air filter change.

3.7.2 Manufacturer's Representative

The engine generator-set manufacturer shall furnish a qualified representative to supervise the installation of the engine generator-set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment.

3.8 INSTRUCTIONS

Two sets of instructions shall be typed in 8 1/2 x 11 inches format, laminated in weatherproof plastic, and placed in three-ring vinyl binders. The binders shall be placed as directed by the Contracting Officer. The instructions shall be in place prior to acceptance of the engine generator set installation. First set of instructions shall include a one-line diagram, wiring and control diagrams and a complete layout of the system. Second set of instructions shall include the condensed operating instructions describing manufacturer's pre-start checklist and precautions; startup procedures for test-mode, manual-start mode, and automatic-start mode (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions. Instructions shall include procedures for interrelated equipment (such as heat recovery systems, co-generation, load-shedding, and automatic transfer switches).

3.9 ACCEPTANCE

Final acceptance of the engine-generator set will not be given until the Contractor has successfully completed all tests and after all defects in installation material or operation have been corrected.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 16 - ELECTRICAL

SECTION 16410A

AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 GENERAL REQUIREMENTS
 - 1.3.1 Standard Product
 - 1.3.2 Nameplate
- 1.4 SERVICE CONDITIONS

PART 2 PRODUCTS

- 2.1 AUTOMATIC TRANSFER SWITCH (ATS)
 - 2.1.1 Override Time Delay
 - 2.1.2 Transfer Time Delay
 - 2.1.3 Return Time Delay
 - 2.1.4 Engine Shutdown Time Delay
 - 2.1.5 Exerciser
 - 2.1.6 Auxiliary Contacts
 - 2.1.7 Supplemental Features
 - 2.1.8 Operator
 - 2.1.9 Override Switch
 - 2.1.10 Green Indicating Light
 - 2.1.11 Red Indicating Light
- 2.2 BY-PASS/ISOLATION SWITCH (BP/IS)
 - 2.2.1 Design
 - 2.2.2 Switch Construction
- 2.3 ENCLOSURE
 - 2.3.1 Construction
 - 2.3.2 Cleaning and Painting
- 2.4 TESTING
 - 2.4.1 Factory Testing
 - 2.4.2 Factory Test Reports
- 2.5 FACTORY TESTING (MEDICAL FACILITIES)
 - 2.5.1 Viewing Ports
 - 2.5.2 Operating Handles

PART 3 EXECUTION

- 3.1 INSTALLATION
- 3.2 INSTRUCTIONS
- 3.3 SITE TESTING

-- End of Section Table of Contents --

SECTION 16410A

AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117 (1997) Operating Salt Spray (Fog) Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.13 (1990; R 1995) Low-Voltage AC Power Circuit Breakers Used in Enclosures

IEEE C37.90.1 (1989; R 1994) IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems

IEEE C62.41 (1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits

IEEE Std 602 (1996) Electric Systems in Health Care Facilities

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1 (1993) Industrial Controls and Systems

NEMA ICS 2 (1993) Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC

NEMA ICS 4 (1997) Industrial Control and Systems Terminal Blocks

NEMA ICS 6 (1993) Industrial Control and Systems, Enclosures

NEMA ICS 10 (1999) Industrial Control and Systems: AC Transfer Switch Equipment - Part 2: Static AC Transfer Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

NFPA 110 (1999) Emergency and Standby Power Systems

UNDERWRITERS LABORATORIES (UL)

| | |
|---------|--|
| UL 1008 | (1996; Rev thru Feb 1999) Transfer Switch Equipment |
| UL 1066 | (1997) Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Switches;

Schematic, external connection, one-line schematic and wiring diagram of each ATS assembly. Interface equipment connection diagram showing conduit and wiring between ATS and related equipment. Device, nameplate, and item numbers shown in list of equipment and material shall appear on drawings wherever that item appears. Diagrams shall show interlocking provisions and cautionary notes, if any. Operating instructions shall be shown either on one-line diagram or separately. Unless otherwise approved, one-line and elementary or schematic diagrams shall appear on same drawing.

Equipment;

Installation;

Dimensioned plans, sections and elevations showing minimum clearances, weights, and conduit entry provisions for each ATS.

SD-03 Product Data

Material;

Equipment;

List of proposed equipment and material, containing a description of each separate item.

SD-06 Test Reports

Testing;

A description of proposed field test procedures, including proposed date and steps describing each test, its duration and expected results, not less than 2 weeks prior to test date.

Certified factory and field test reports, within 14 days following completion of tests. Reports shall be certified and dated and shall demonstrate that tests were successfully completed prior to shipment of equipment.

SD-07 Certificates

Equipment;
Material;

Certificates of compliance showing evidence of UL listing and conformance with applicable NEMA standards. Such certificates are not required if manufacturer's published data, submitted and approved, reflect UL listing or conformance with applicable NEMA standards.

Switching Equipment;

Evidence that ATS withstand current rating (WCR) has been coordinated with upstream protective devices as required by UL 1008. Upon request, manufacturer shall also provide notarized letter certifying compliance with requirements of this specification, including withstand current rating.

SD-10 Operation and Maintenance Data

Switching Equipment;
Instructions;

Six copies of operating manual outlining step-by-step procedures for system startup, operation, and shutdown. Manual shall include manufacturer's name, model number, service manual, parts list, and brief description of equipment and basic operating features. Manufacturer's spare parts data shall be included with supply source and current cost of recommended spare parts. Six copies of maintenance manual listing routine maintenance, possible breakdowns, repairs, and troubleshooting guide. Manual shall include simplified wiring and control diagrams for system as installed.

1.3 GENERAL REQUIREMENTS

1.3.1 Standard Product

Material and equipment shall be standard products of a manufacturer regularly engaged in manufacturing the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. The experience use shall include applications in similar circumstances and of same design and rating as specified ATS. Equipment shall be capable of being serviced by a manufacturer-authorized and trained organization that is, in the Contracting Officer's opinion, reasonably convenient to the site.

1.3.2 Nameplate

Nameplate showing manufacturer's name and equipment ratings shall be made of corrosion-resistant material with not less than 1/8 inch tall characters. Nameplate shall be mounted to front of enclosure and shall comply with nameplate requirements of NEMA ICS 2.

1.4 SERVICE CONDITIONS

Seismic requirements shall be as specified in Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT, 15070 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT and 16070 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT .
ATS shall be suitable for prolonged performance under following service

conditions:

- a. Altitude: 4800 feet above mean sea level.
- b. Relative Humidity: 80 percent maximum, continuous.
- c. Temperature: 24 to 92__ degrees F.
- d. Seismic Parameters: seismic zone 4.

PART 2 PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCH (ATS)

ATS shall be electrically operated and mechanically held in both operating positions. ATS shall be suitable for use in emergency systems described in NFPA 70. ATS shall be UL listed. ATS shall be manufactured and tested in accordance with applicable requirements of IEEE C37.90.1, IEEE C37.13, IEEE C62.41, IEEE Std 602, NEMA ICS 1, NEMA ICS 2, NEMA ICS 10, UL 1008 and UL 1066. ATS shall conform to NFPA 110. To facilitate maintenance, manufacturer's instruction manual shall provide typical maximum contact voltage drop readings under specified conditions for use during periodic maintenance. Manufacturer shall provide instructions for determination of contact integrity. ATS shall be rated for continuous duty at specified continuous current rating. ATS shall be fully compatible and approved for use with BP/IS specified. BP/IS shall be considered part of ATS system. ATS shall have following characteristics:

- a. Voltage: 208 volts ac.
- b. Number of Phases: Three.
- c. Number of Wires: Four.
- d. Frequency: 60 Hz.
- e. Poles: Three switched and switched neutral .
- f. ATS WCR: Rated to withstand short-circuit current of 18,000 amperes, RMS symmetrical.
- g. Nonwelding Contacts: Rated for nonwelding of contacts when used with upstream feeder overcurrent devices shown and with available fault current specified.
- h. Main and Neutral Contacts: Contacts shall have silver alloy composition. Neutral contacts shall have same continuous current rating as main or phase contacts .

2.1.1 Override Time Delay

Time delay to override monitored source deviation shall be adjustable from 0.5 to 6 seconds and factory set at 1 second. ATS shall monitor phase conductors to detect and respond to sustained voltage drop of 25 percent of nominal between any two normal source conductors and initiate transfer action to emergency source and start engine driven generator after set time period. Pickup voltage shall be adjustable from 85 to 100 percent of nominal and factory set at 90 percent. Dropout voltage shall be adjustable from 75 to 98 percent of pickup value and factory set at 85 percent of

nominal.

2.1.2 Transfer Time Delay

Time delay before transfer to emergency power source shall be adjustable from 0 to 5 minutes and factory set at 0 minutes. ATS shall monitor frequency and voltage of emergency power source and transfer when frequency and voltage are stabilized. Pickup voltage shall be adjustable from 85 to 100 percent of nominal and factory set at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal and factory set at 90 percent.

2.1.3 Return Time Delay

Time delay before return transfer to normal power source shall be adjustable from 0 to 30 minutes and factory set at 30 minutes. Time delay shall be automatically defeated upon loss or sustained undervoltage of emergency power source, provided that normal supply has been restored.

2.1.4 Engine Shutdown Time Delay

Time delay shall be adjustable from 0 to 30 minutes and shall be factory set at 10 minutes.

2.1.5 Exerciser

Provide a generator exerciser timer. Run times shall be user programmable.

The generator exerciser shall be selectable between load transfer and engine run only, and shall have a fail-safe feature that will retransfer the ATS to normal during the exercise period.

2.1.6 Auxiliary Contacts

Two normally open and two normally closed auxiliary contacts rated at 15 amperes at 120 volts shall operate when ATS is connected to normal power source, and two normally open and two normally closed contacts shall operate when ATS is connected to emergency source.

2.1.7 Supplemental Features

ATS shall be furnished with the following:

- a. Engine start contact.
- b. Emergency source monitor.
- c. Test switch to simulate normal power outage.
- d. Voltage sensing. Pickup voltage adjustable from 85 to 100 percent of nominal; dropout adjustable from 75 to 98 percent of pickup.
- e. Time delay bypass switch to override return time delay to normal.
- f. Manual return-to-normal switch.
- g. Means shall be provided in the ATS to insure that motor/transformer load inrush currents do not exceed normal starting currents. This shall be accomplished with either in-phase monitoring, time-delay transition, or load voltage decay

sensing methods. If manufacturer supplies an in-phase monitoring system, the manufacturer shall indicate under what conditions a transfer cannot be accomplished. If the manufacturer supplies a time-delay transition system, the manufacturer shall supply recommendations for establishing time delay. If load voltage decay sensing is supplied, the load voltage setting shall be user programmable.

2.1.8 Operator

Manual operator conforming to UL 1008 shall be provided, and shall incorporate features to prevent operation by unauthorized personnel. ATS shall be designed for safe manual operation under full load conditions. If manual operation is accomplished by opening the door, then a dead-front shall be supplied for operator safety.

2.1.9 Override Switch

Override switch shall bypass automatic transfer controls so ATS will transfer and remain connected to emergency power source, regardless of condition of normal source. If emergency source fails and normal source is available, ATS shall automatically retransfer to normal source.

2.1.10 Green Indicating Light

A green indicating light shall supervise/provide normal power source switch position indication and shall have a nameplate engraved NORMAL .

2.1.11 Red Indicating Light

A red indicating light shall supervise/provide emergency power source switch position indication and shall have a nameplate engraved EMERGENCY.

2.2 BY-PASS/ISOLATION SWITCH (BP/IS)

2.2.1 Design

Bypass/isolation switch (BP/IS) shall permit load by-pass to either normal or emergency power source and complete isolation of associated ATS, independent of ATS operating position. BP/IS and associated ATS shall be products of same manufacturer and shall be completely interconnected and tested at factory and at project site as specified. BP/IS shall be manufactured, listed, and tested in accordance with paragraph AUTOMATIC TRANSFER SWITCH (ATS) and shall have electrical ratings that exceed or equal comparable ratings specified for ATS. Operating handles shall be externally operated and arranged so that one person can perform the bypass and isolation functions through the operation of a maximum of two handles within 5 seconds. The ATS shall have provisions for locking in the isolation position. Handle for manual operation shall be permanently attached to operating mechanism. BP/IS operation shall be accomplished without disconnecting switch load terminal conductors. Isolation handle positions shall be marked with engraved plates or other approved means to indicate position or operating condition of associated ATS, as follows:

- a. Indication shall be provided to show that ATS section is providing power to the load.
- b. Indication shall be provided of ATS isolation. The ATS controls shall remain functional with the ATS isolated or in bypass mode to

permit monitoring of the normal power source and automatic starting of the generator in the event of a loss of the normal power source. In the isolated mode, the bypass section shall be capable of functioning as a manual transfer switch to transfer the load to either power source. The ATS shall be capable of undergoing functional operation testing without service interruption. The ATS may also be completely removed from the enclosure, if required for maintenance or repair, while the bypass section continues to power the load.

2.2.2 Switch Construction

Bypass/isolation switch shall be constructed for convenient removal of parts from front of switch enclosure without removal of other parts or disconnection of external power conductors. Contacts shall be as specified for associated ATS, including provisions for inspection of contacts without disassembly of BP/IS or removal of entire contact enclosure. To facilitate maintenance, manufacturer shall provide instructions for determination of contact integrity. BP/IS and associated ATS shall be interconnected with suitably sized copper bus bars silver-plated at each connection point, and braced to withstand magnetic and thermal forces created at WCR specified for associated ATS.

2.3 ENCLOSURE

ATS and accessories shall be installed in wall-mounted , ventilated NEMA ICS 6, Type 4 , smooth sheet metal enclosure constructed in accordance with applicable requirements of UL 1066 and/or UL 1008. Intake vent shall be screened and filtered. Exhaust vent shall be screened. Door shall have suitable hinges, locking handle latch, and gasketed jamb. Metal gauge shall be not less than No. 14. Enclosure shall be equipped with at least two approved grounding lugs for grounding enclosure to facility ground system using No. 4 AWG copper conductors. Factory wiring within enclosure and field wiring terminating within enclosure shall comply with NFPA 70. If wiring is not color coded, wire shall be permanently tagged or marked near terminal at each end with wire number shown on approved detail drawing. Terminal block shall conform to NEMA ICS 4. Terminals shall be arranged for entrance of external conductors from bottom of enclosure as shown. Main switch terminals, including neutral terminal if used, shall be pressure type suitable for termination of external copper conductors shown.

2.3.1 Construction

Enclosure shall be constructed for ease of removal and replacement of ATS components and control devices from front without disconnection of external power conductors or removal or disassembly of major components. Enclosure of ATS with BP/IS shall be constructed to protect personnel from energized BP/IS components during ATS maintenance.

2.3.2 Cleaning and Painting

Both the inside and outside surfaces of an enclosure, including means for fastening, shall be protected against corrosion by enameling, galvanizing, plating, powder coating, or other equivalent means. Protection is not required for metal parts that are inherently resistant to corrosion, bearings, sliding surfaces of hinges, or other parts where such protection is impractical. Finish shall be manufacturer's standard material, process, and color and shall be free from runs, sags, peeling, or other defects. An enclosure marked Type 1, 3R, 4 or 12 shall be acceptable if there is no

visible rust at the conclusion of a salt spray (fog) test using the test method in ASTM B 117, employing a 5 percent by weight, salt solution for 24 hours. Type 4X enclosures are acceptable following performance of the above test with an exposure time of 200 hours.

2.4 TESTING

2.4.1 Factory Testing

A prototype of specified ATS shall be factory tested in accordance with UL 1008. In addition, factory tests shall be performed on each ATS as follows:

- a. Insulation resistance test to ensure integrity and continuity of entire system.
- b. Main switch contact resistance test.
- c. Visual inspection to verify that each ATS is as specified.
- d. Mechanical test to verify that ATS sections are free of mechanical hindrances.
- e. Electrical tests to verify complete system electrical operation and to set up time delays and voltage sensing settings.

2.4.2 Factory Test Reports

Manufacturer shall provide three certified copies of factory test reports.

2.5 FACTORY TESTING (MEDICAL FACILITIES)

The factory tests for ATS and By-Pass/Isolation switches used in medical facilities shall be conducted in the following sequence:

- a. General
- b. Normal
- c. Overvoltage
- d. Undervoltage
- e. Overload
- f. Endurance
- g. Temperature Rise
- h. Dielectric Voltage-Withstand
- i. Contact Opening
- j. Dielectric Voltage-Withstand (Repeated)
- k. Withstand
- l. Instrumentation and Calibration of High Capacity
- m. Closing
- n. Dielectric Voltage-Withstand (Repeated)
- o. Strength of Insulating Base and Support

2.5.1 Viewing Ports

ATS and BP/IS switches shall be of draw-out construction. Viewing ports to inspect the contacts without requiring disassembly shall be provided.

2.5.2 Operating Handles

The operating handles shall be externally operated, and designed and constructed not to stop in an intermediate or neutral position during

operation, but shall permit load by-pass and transfer switch isolation in no more than two manual operations which can be performed by one person in 5 seconds or less. The transfer speed will be independent of the operational speed of the switch handle or handles.

PART 3 EXECUTION

3.1 INSTALLATION

ATS shall be installed as shown and in accordance with approved manufacturer's instructions.

3.2 INSTRUCTIONS

Manufacturer's approved operating instructions shall be permanently secured to cabinet where operator can see them. One-line and elementary or schematic diagram shall be permanently secured to inside of front enclosure door.

3.3 SITE TESTING

Following completion of ATS installation and after making proper adjustments and settings, site tests shall be performed in accordance with manufacturer's written instructions to demonstrate that each ATS functions satisfactorily and as specified. Contractor shall advise Contracting Officer not less than 5 working days prior to scheduled date for site testing, and shall provide certified field test reports within 2 calendar weeks following successful completion of site tests. Test reports shall describe adjustments and settings made and site tests performed. Minimum operational tests shall include the following:

- a. Insulation resistance shall be tested, both phase-to-phase and phase-to-ground.
- b. Power failure of normal source shall be simulated by opening upstream protective device. This test shall be performed a minimum of five times.
- c. Power failure of emergency source with normal source available shall be simulated by opening upstream protective device for emergency source. This test shall be performed a minimum of five times.
- d. Low phase-to-ground voltage shall be simulated for each phase of normal source.
- e. Operation and settings shall be verified for specified ATS features, such as override time delay, transfer time delay, return time delay, engine shutdown time delay, exerciser, auxiliary contacts, and supplemental features.
- f. Manual and automatic ATS and BP/IS functions shall be verified.

-- End of Section --